NATURE

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

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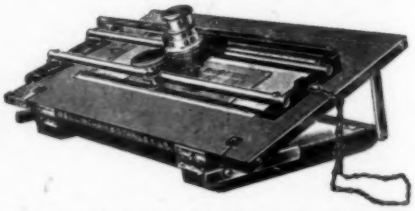

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Vol. 147 SATURDAY, MARCH 15, 1941 No. 3724

POPULATION PROBLEMS AND EDUCATIONAL POLICY

UNDER present conditions in the Western World we are faced with a decline in the population which shows every sign of attaining serious dimensions over the coming decades, a decline unparalleled by anything that has happened in human history before. The decline will be most strongly felt in Scandinavian countries, in the white portions of the British Empire, among other nations of Western Europe, and in the United States ; but there is every indication that as time goes on it will extend to all parts of the earth, affecting every race and colour. Opinion may be divided over the immediate causes which have led to the fall in the birth-rate below replacement level. It is significant, however, that it has come about first among those nations which have been foremost in the discovery and application of science. It is significant, too, that the decrease in births has occurred in countries where living standards are higher than elsewhere, so that it can have no relation to the problem of mere survival in any Malthusian sense, and its explanation must be sought in the complex of economic organization and personal ideals which help to make up the present social order.

This decline in the reproduction rate of certain peoples is not without its tragedies. In recent years, for example, the Jews in Central Europe have been limiting their births more severely than the nations among whom they have been living. With whatever eyes we may look upon the persecutions and indignities to which they have been subjected, and the efforts made to transport them from one place to another, if left in peace their numbers would have shown a marked falling off even in a generation's time, and the decline might well have been progressive. Similarly, as we watch and take part in the magnificent fight which the British Empire is putting up against the Totalitarian Powers, we cannot escape the realization that in a few decades' time, the democratic nations will be considerably weaker in effective man-power than they are now. Victory will have been dearly bought if its fruits sink below a rising tide of superior numbers in other parts of the world. If the British people are to continue as a world power, in any sense of the term, it is imperative that a positive demographic policy should be put into practice, and soon rather than late.

Nor are the problems which a declining birth-rate brings upon us restricted to the international field. Great and almost more pressing ones face us at home. It was among the wealthier classes that the practice of family limitation first came to be adopted. This may prove to be a temporary phase ; but while it continues it results in a situation in which the greater part of the next generation is recruited from the lower strata of society, and from those who with the largest families have the greatest struggle to provide the barest essentials of life in the form of food, nursing care and house room. Whether such a state of affairs will lead to any disgenic results, and so produce another type of national decline, is still a moot point. From the pioneer work of M'Gonigle, Orr, and now of many others, it is abundantly clear that the poorer sections of the community, even in normal times of peace, if members of families with several dependants, are cramped in their health and physical development, not to mention those intellectual and cultural influences which civilization should confer. To see that such people receive sufficient for their full physical development would not be an increased burden, but a wise and beneficial investment, which would reveal itself in the improved effectiveness of the nation, whether on the battlefield, in the factory or in the home. Alternatively, the wealthier and professional

classes, with more house room and easier standards of life, are not reproducing their numbers; they are not, therefore, bearing their full share in the production of the future British nation, which their higher living standards, their richer cultural environment, and, in some cases at any rate, their superior intellectual endowments should lead us to expect.

Here we are face to face with the crux of the whole problem. At the present time, parents of the wealthier classes have stronger inducements to restrict their families than any other section of the community. They live in an environment in which child-bearing is unpopular, nursing and medical care is expensive; the parent has to see his child through long years at preparatory and public schools, and then at the university, before finally having to produce the capital to see his son launched successfully on a professional or business career. On a proportionate but lower scale the cost of producing and educating daughters is also formidable. While such a state of affairs continues—and it is not easy to visualize any early remedy—the idea of a small family will be extremely difficult to overcome, and since social codes spread from above downwards, it seems likely to affect all grades of society until a considerable amount of social reconstruction has been carried through.

At this stage in the demographic progress of the nation it is interesting but disquieting to observe how acquiescent public opinion and even our intellectual and political leaders are in a situation which, if left to itself, may develop into a national calamity. The reason for this cannot be due to lack of information, for the facts as outlined above have been available for some time past to all readers. The prevailing impression appears to be that some fall in the population of Great Britain would be welcome, and that in the long run things will right themselves. One or two economists have directed attention to the prospects of decreasing markets, and to shifts in consumer demand, but their discussions have borne the impression of being mainly theoretical and of no immediate moment. On the other hand, signs of a change in social emphasis are beginning to appear. The scheme for cheaper milk to children and mothers, under which in certain circumstances it can be provided free, although introduced to alleviate the severity of war-time rationing, is a step in the right direction. A more considerable one would be the introduction of a national scheme of family allowances, particularly if its scales were made elastic enough to cover all social grades. Support for the idea of family allowances is growing perceptibly at the present time, but the Government has announced in the House of Lords that the Government cannot find the necessary funds for such a scheme during the War. Curiously enough, opposition to family allowances comes more from the ranks of organized labour, where their effect would be most beneficial, than from those who would have to bear the extra budgetary cost.

So far, the fall in the child population has passed almost unnoticed by health and education authorities, for it has led to concealed, but none the less real, economies in buildings and staff. It has been among the public schools that the fall in recruitment has begun to show itself in the form of actual financial stringency, as well as in empty boarding houses. Among the public schools the decline in numbers has gone so far, having been aggravated by the War, that the Headmasters' Conference has taken the matter up, and the Board of Education is being sounded to see what assistance may be forthcoming from the State. Since discussions are still proceeding it is impossible to forecast what may emerge. Judging from what has appeared in the Press, there are indications that efforts will be made to retain the boarding-school principle, while extending the scope of entry through some form of public assistance.

All such proposals are purely short-range and empirical in character. Although they may contain the seeds of a genuine demographic policy, they are not looked upon in that light by those who have brought them forward. In fact, we have to realize that demographic problems have not yet reached the arena of practical politics anywhere in the British Empire, whether we are thinking of the white people whose numbers are about to decline, or of the coloured races who, under British rule, are multiplying so rapidly that with them Malthusian conditions actually or very nearly apply. Social distress in the West Indies, in India, too, and empty cradles in Great Britain are complementary evidence that to the great majority of our leaders no demographic problem is thought to exist. Such conditions point to the vast field of social welfare and betterment that is waiting to be taken up.

In approaching this field, however, the only line promising any kind of permanent success lies through education, particularly through the application of those biological principles which may be

termed human biology. What is envisaged is a reorientation of social and personal ideals, so that individualism and money standards no longer hold full sway. The public schools, for example, must come in for a good deal of reconstruction. Founded as most of them were when children were plentiful, and when women in consequence were accorded a low status, they have accentuated the separation of the sexes and imposed a monastic mode of life upon the boys as well as upon the staff. Through their character training they have extolled the ideal of masculine individuality. The leadership principle is the antithesis of co-operative work involving all kinds of people and both sexes. From now on, leadership to be at all effective as a social force must involve responsibility for rather more children than with other grades of society. Such questions as these have been elaborated in greater detail in a memorandum on "Human Biology and the Crisis in the Public Schools"[1] issued recently by the Educational Advisory Board of the British Social Hygiene Council. The memorandum merits careful consideration by all who are concerned with the future of the British nation, as well as by those primarily interested in the educational policy of the public schools.

If entry to the public schools is to be widened to maintain numbers, one immediate result may be to intensify the desire in parents to limit their families. To counteract such an influence, in granting its assistance the State should impose conditions calling for reforms in teaching practice and educational aims. For the future it will be necessary to inculcate the idea that girls and women are true partners in life of boys and men, that many of the finest rewards in life, its tenderest emotions and greatest personal satisfactions lie in the home. Sex must be freed from its associations of false sentimentality and furtive pleasures, and made the subject of rational thought and conduct. This should make for greater happiness in providing a more natural framework for human activities and desires, tending to reduce many of the frustrations which now bear so heavily upon society.

In bringing about a new orientation of social standards it is very probable that educational practice will lag behind political expediency, for educational policy is nearly always conservative. The State will have to assume the role of a true parent to its children. To achieve this, the present system of financial rewards in the shape of wages, salaries and profits may need to be modified in keeping with a more co-operative form of community, in which returns bear a closer relation to the biological responsibilities of individual members. As indicated above, a bold scheme of family allowances would make a big difference. Social and economic rearrangements of this nature would not be in any way subversive, for they would make for a stronger and a healthier nation. They would also provide a bulwark for democracy, for once the principle of family limitation is recognized, the task of bearing children is one of the last that public authorities will be able to impose upon private individuals. The true source of democracy is the home, and it is from healthy and well-satisfied homes that the future members of the British nation must eventually come.

[1] Educational Advisory Board, British Social Hygiene Council, Tavistock House South, Tavistock Square, W.C.1. Gratis.

THE MYSTERY OF RUST

The Corrosion of Iron and Steel

Being a General Account of the Work of the Corrosion Committee of the Iron and Steel Institute and the British Iron and Steel Federation. By Dr. J. C. Hudson. Pp. xv+319+43 plates. (London: Chapman and Hall, Ltd., 1940.) 18s. net.

THE late Sir Robert Hadfield made a hobby of collecting statistics about steel, including the loss caused by corrosion; he mentioned at a time when the world slump was at its height that the destruction due to corrosion that year was probably greater than the total production of new steel. He might well have added, what are we chemists and metallurgists doing about it?

For many years the only remedy was paint: the painting of the Forth Bridge has been described as an eternal circle of operations. When I was a student, G. T. Moody propounded a theory on what happens when iron rusts, which promptly brought forth a rival one from Wyndham Dunstan: engineers were aghast at the temerity of chemists in interfering with the normal happenings of Nature, and were not surprised that the chemists failed to agree. Forty years on, and the bad old times when iron rusted are giving way to the new age of rustless alloys, official committees of investigation, some understanding of the problem, and a considerable amount of first-class research.

It is estimated that the annual cost, including labour, of protecting the iron- and steel-work in

Great Britain amounts to £40 million: in the United States 120 million gallons of paint per annum are applied to ferrous metals. It is obvious that a minute percentage on these bills would provide very large sums for research, and it may be asked why the world is not sufficiently enlightened to-day to insist on such a levy. In the days to come the world will not be able to afford to let iron rust at this rate.

Something, however, is being done, and it is the purpose of Dr. Hudson's book to tell the story of the Corrosion Committee. It was formed in 1928 under the chairmanship of Dr. W. H. Hatfield; it has representatives of producers and scientific workers and the direct support of industry both in kind and through the industrial research laboratories. It is one of those typically British volunteer organizations in which the spur is the love of the cause and the reward is the fact that something has been accomplished. Such a team requires above all leadership, and whether he functions as coach or stroke, Dr. Hatfield has given clear proof that he can provide this. Financial help is provided by the Department of Scientific and Industrial Research, by the Admiralty, Lloyd's and the British Steelworks Association: it is inconceivable that such a cause should be short of the necessary funds. There is similar work in hand abroad, mostly looked after by co-ordinating committees, and the book gives a short note about the activities in six countries, the most important being the United States. Needless to say, there is, or was, close international co-operation in these matters..

An iron plate rusts in a single night by chemical action, the jute fibres of a sandbag are rotted within three weeks in hot weather by bacteriological action: clearly the affinity of iron for oxygen is very great. Any investigation must discover the factors causing rusting and the possibility of their removal. To prevent rusting, both the resistance of iron and steel to rusting and the means of protection against rusting must be improved. These are the essentials of the problem. How are they to be tackled?

The late Prof. H. E. Armstrong tried to train his engineering students on the detective problem, "What happens when iron rusts". Put bluntly, they resented being taught chemistry in this way, being "forced to think" as he said, and wanted to have facts thrown across the lecture table, which they could catch and throw back in the examination. Perhaps engineers have been too ready to accept the fact that iron rusts and adopt a fatalistic attitude to the phenomenon.

The problem of rust must be tackled from the point of view of the shape of things to come, which is week by week being developed in the editorial columns of NATURE. Rusting is as much as anything due to the pollution of the air in our cities: let us therefore have clean air. This can largely be effected by legislation: the people need clean air just as much as iron does. Let us have clean air just as we have clean water: the opposition of the interests who would have us burn raw coal must be swept away. The politicians play with the things the mass mind can grasp, and the big problems that matter are left for the most part to find their own solution in the efflux of time. Surely science can make the mass mind grasp the need for clean air.

Steel can be rendered almost entirely resistant to rusting by suitably altering its composition, but this is costly—too costly in fact for other than special application. Nickel costs £200 a ton, and only 113,000 tons were produced in 1937: there must be more nickel produced at a much lower cost—a monopoly, if there be one, must disappear, for it is not in the public interest.

The book is a general summary of the first ten years' work of the Corrosion Committee and describes it in very readable form. If a reviewer is entitled to skip and turn to the end, as some people do with a detective story, then we may turn to Chapter xi, where what has been accomplished is set out clearly and succinctly.

The positive results fall under two heads. One is the development of low-alloy rust-resisting steels, largely carried out across the Atlantic, which has enabled the resistance of structural steel to rusting to be doubled. The other is a multitude of improvements in painting procedure. Even more important probably is the far greater understanding of the problems, both generally and in detail, which will ensure future progress being much more rapid.

The possibilities of low-alloy steels are immense; their development waits on the elaboration of methods for their fabrication, but these are rapidly forthcoming. Protective coatings of greater durability, involving the use of synthetic plastics as paint components, also promise to give better and cheaper maintenance.

Great progress has been made with special steels for the chemical and oil-refining industries, which must have these and can afford to pay the price for them. Here, as always, there is a race between demand and accomplishment.

Iron rusts in the air, under the ground and in the sea; this is its nature. Man needs bridges in the air, pipes under the earth and ships at sea; he must face the challenge how to make them last longer. In the long run, the effort is one of trained brains, helped by time and money. We can see to it that the training is not lacking and that the right men are given their chance to achieve.

E. F. ARMSTRONG.

EMPIRICISM IN METAPHYSICS

The Nature of the World

An Essay in Phenomenalist Metaphysics. By W. T. Stace. Pp. vii + 262. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1940.) 18*s*. 6*d*. net.

THE book which bears this ambitious title is an essay in metaphysics on a phenomenalist basis. As was to be expected, the course of the inquiry leads the author to discuss most of the problems of philosophy. This fact may perhaps excuse any tardiness in this notice of the work, for it would be a poor compliment to the writer to offer an impression gained after a hasty reading. After two careful readings of this book I can say that, though I still disagree with the method and many of the conclusions, it is in my opinion one of the most important contributions to metaphysics which have appeared in recent years.

Prof. Stace is a thorough-going empiricist, at least in intention. The point where argument would break out is precisely whether the intention has really been fulfilled. Has any material been used in the construction which is not, in the strict sense, derived from experience? It seems to me that there is an *a priori* element in the metaphysical construction, and that it comes in at the place where Leibniz suggested that the *a priori* must be introduced when he added to the formula of empiricism "Nihil in intellectu quod non prius fuerit in sensu," the phrase "nisi intellectus ipse".

However this may be, Prof. Stace conceives the purpose and method of philosophy in a thoroughly empirical and 'scientific' manner. The proper method of philosophy is, in his opinion, that of hypothesis. "An hypothesis is put forward regarding the nature of the concrete. An attempt is then made to show that this hypothesis 'explains' the known facts about the world. Finally, reasons are given why this hypothesis should be preferred to others which equally explain the facts." It should be added, however, that by 'explain' Prof. Stace means very much what science means by it, and not the finding of reasons for things or answers to the question 'why?'. It will be seen that Prof. Stace renounces the kind of insight which many philosophers have sought—one which would grasp the world as a rational whole and would find that in the end reality and value were reconciled.

The central concept of this metaphysical construction is that of the cell. The hypothesis put forward is that the universe is a plurality of cells, all of which are of the same fundamental structure. Nothing exists except cells. Though the metaphysical conception of cells is, of course, suggested by the biological, it has properties which differentiate it from any scientific hypothesis. A metaphysical cell is absolutely indivisible. It is not material nor is it spiritual; it is the concrete reality of which matter and spirit are abstract aspects. Every cell consists of two parts, consciousness and datum, and cells differ in the quantitative and qualitative characters of their data. No doubt the hypothesis thus baldly stated has a paradoxical air, but its working out is calculated to remove the prejudices of common sense.

Naturally, Prof. Stace realizes that his theory has a resemblance to Leibniz's philosophy of monads, and it must be added that one of the most startling of Leibniz's assertions concerning his monads is repeated by Prof. Stace about his cells—they do not interact, they "have no windows". Leibniz felt that the appearance of interaction deserved at least some explanation, and he devised, to meet this need, his famous theory of the "pre-established harmony". Prof. Stace feels no such need; sufficient for him that in fact the cells do so function and develop that they appear to be interacting, that there is "cellular correspondence". It seems to me that other readers as well as myself will consider this cellular correspondence an odd feature of the world for which they would like an explanation, but Prof. Stace would reply that we were searching for what we cannot have—reasons.

It would be interesting to touch upon some more topics on which Prof. Stace has invited argument, He maintains that all consciousness is thinking, and that there is no such thing as will. In order to carry out this hypothesis, he has to employ the notion of "submerged concepts". Again, on the subject of values, he contends that the validity of value judgments and their universality has nothing to do with the "so-called objectivity" of values. This is a discussion which deserves attention.

I cannot think that what Prof. Stace has to say on religion and the reality of God is quite on the level of the rest of his book. He has perhaps not allowed himself sufficient space, and it may be hoped that he will devote a separate volume to the philosophy of religion.

W. R. MATTHEWS.

UTILIZATION OF CHEMICAL LITERATURE

Chemical Productions

Their Nature and Use. By Prof. M. G. Mellon. (International Chemical Series.) Second edition. Pp. xii+284. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 18*s*.

IN spite of the fact that during the last decade there has been an enormous increase in chemical literature, Prof. M. G. Mellon has been able to retain substantially in its original form the classification evolved in the first edition of this work. As the author's desire is to provide a text-book for an undergraduate course in chemical literature, this classification is based rather on the nature of the publication in which the information appears than on the nature of the subject-matter. Thus, in the first place, he divides the literature into publications containing new material or new presentations and discussions of known material, designating these "Original Sources (Unorganised Information)"; publications containing information compiled from an original source arranged according to some definite plan, which he designates "Secondary Sources (Organised Information)".

Under the heading "Original Sources" there are four subdivisions, namely, periodicals, contributions of institutions, literature on patents, and miscellaneous contributions. "Secondary Sources" are subdivided into periodicals and serials, bibliographies, general works of reference and text-books, and miscellaneous compilations.

A separate chapter is devoted to each sub-class, and, apart from general descriptions of each type of chemical literature, a great deal of useful information will be found. For example, lists are given of journals available on general science in the different countries of the world, together with a note of the standard abbreviations used in citing references to the periodicals. In the same way general chemical journals are listed in chronological order of appearance. These include the earliest journals available, and all the more important later ones, the list being of particular interest in that it indicates the length of life of these publications.

Current journals which are mainly devoted to specialized branches of chemistry are classified under the headings used in *Chemical Abstracts*. In this case titles were selected by some one interested in the particular subject, and accordingly the list embodies the more generally useful periodicals classified under thirty different headings.

There are included in the book in addition many valuable suggestions leading to a greater understanding of the potentialities of chemical literature. Whether the student is concerned with patent searches, abstraction of journals, the compilation of bibliographies or some specialized research in the chemical literature, he will find it helpful and time-saving to follow the general principles laid down by the author.

Finally, in order to stimulate actual contact with the publications in question, there are appended a number of study sheets or library problems relevant to certain sections of the book. These, it is suggested, might provide the basis of a practical library course in chemical literature.

CORN GROWING IN THE OLD DAYS

Corn Country

By C. Henry Warren. Pp. viii+136+34 plates. (London: B. T. Batsford, Ltd., 1940.) 10*s*. 6*d*. net.

CORN growing in Great Britain falls roughly into three periods: the open field period from early times up to the end of the eighteenth century; the craftsman period which attained its highest development during the years 1850 to 1880; and the modern period in which science and machinery dominate, and which set in about 1890. The countryside now shows little but vestigial remnants of the open field system, but memories of the craftsman period still linger among the old men, and form part of the background of our village life. Happily, various modern writers have discovered the literary value of English country life, and a considerable number of books are being written about it; some by those who have actually gone through what they describe, such as Fred Kitchen, a farm worker with a natural gift for writing; others by men who have explored farms and villages to note down what they could see and hear.

Mr. Warren's book belongs to this second group: he has succeeded in putting together a very interesting account of the first two periods. For the story of the open fields he has gone back to some of the old records and has reproduced pictures from the well-known Grimani and Louterell psalters.

But the greater part of the book is an account of the craftsman period as remembered by the older

men, and tinged by the mellow light that, fortunately for human beings, suffuses past recollections and softens their harsh features.

Space does not permit of quotations from some of the talks with old men so fully recorded. But all aspects of corn growing in the old days are attractively dealt with, even to the straw plaiting done by the women and children, and the innumerable patterns of braiding and thatching evolved in the different districts. In spite of its unpromising appearance as a plastic material, the country folk of those days succeeded in working straw into very attractive forms. There was much pride in high farming, and it seems clear that the workers extracted a good deal of satisfaction out of what appears to us to have been a trying life. The illustrations taken from Pyne's "Microcosm" (1822) suggest no hint of hard times—and yet it is certain that they were hard.

The author barely touches the modern period, and then only to condemn it. All the scientific work on the nutrition of the wheat plant, the breeding of improved varieties, and the diseases and insect pests of crops; all the engineers' efforts to make machines for the more rapid execution of the work of sowing and harvesting the crop, and the labours of the economists to find some basis for arriving at the cost of growing it—all this and much more is passed over in a few sentences. The use of nitrogenous top dressings is condemned, although a full-sized picture of a man broadcasting sulphate of ammonia is given. Clearly the author hankers after the craftsman period as seen by those looking back. But he does not explain why the craftsman period came to an end, nor does he suggest any course of action for the perplexed farmer struggling to keep his men on the land and to pay them the statutory minimum weekly wage in addition to the various extras; nor does he show how to meet the chronic shortage of farmyard manure, or to obtain seed of the old varieties of those halcyon days. No explanation is offered as to why, in spite of efforts of Governments and County Councils, the numbers of small holdings shrink, and the possibility of subsistence farming which so much appeals to the author becomes more and more remote. The plain fact seems to be that in spite of the attractiveness of the age of craftsmanship to some members of the intellectual classes, the actual workers prefer the age of science and machinery.

As one expects from the house of Batsford, the illustrations are well chosen and beautifully executed.

E. J. RUSSELL.

PRINCIPLES OF THE REPRODUCTION OF SOUND

Elements of Acoustical Engineering

By Dr. Harry F. Olson. Pp. xv+344. (London: Chapman and Hall, Ltd., 1940.) 30*s*. net.

DR. H. F. OLSEN is in an authoritative position for dealing with the subject of acoustical engineering, and his book will be specially useful to those concerned with acoustics from the point of view of the engineer. It is well written and freely illustrated, and may be understood by anyone familiar with elementary physics and simple electric circuit theory.

The major portion of the book deals with the theory, design and testing of apparatus for the reproduction of sound. Early chapters describe fully the fundamental principles used in modern acoustics, and develop the analogies between electrical, mechanical and acoustical systems. Later chapters describe current acoustical practice in connexion with radio, gramophones, motion pictures and public address systems, and give very full accounts of the characteristics of various forms of microphone, 'pick-up' and loud-speaker.

The treatment of the various aspects of acoustical reproduction is comprehensive, and the fact that Dr. Olsen is speaking mainly about matters of which he, himself, has made a special study possibly explains why more than one quarter of the references in the book are to his own works.

On some general aspects of acoustics Dr. Olsen's treatment is naturally less comprehensive. The review of the subject of speech, music and hearing is a brief one. Supersonics is regarded as outside the scope of the work. On the instrumental measurement of noise, the book describes certain tentative American standards, suggested in 1936, in which a microphone is used in connexion with an amplifier of earlike frequency characteristics and a square law detector. No mention is made of the findings of the international conference held in Paris in 1937, which failed to accept such a standard, or to more recent developments in the objective measurement of noise. However, architectural acoustics and its measurements receive useful notice, especially in relation to the use of reproducing systems in auditoriums.

In brief, the book is to be recommended to all interested in modern acoustics, especially to those concerned with engineering aspects of the recording and reproduction of sound.

Applied Chemistry for Engineers

By Dr. Eric S. Gyngell. Pp. viii+328. (London: Edward Arnold and Co., 1940.) 15*s*. net.

THIS small volume presents in a particularly happy manner an account of many materials used by the engineer and the processes by which they are made, or in which they are used. There are no lengthy tables of analyses or detailed accounts of laboratory methods, but, instead, general descriptions and careful explanations of many terms, such as, for example, 'gas coal', 'cetane number', 'differential aeration' and 'continuous blowdown', with which the engineer is probably familiar, but might have difficulty in defining.

More than half the book is devoted to fuels and combustion, but in view of the fact that the subjects dealt with are, among others, the nature of fuels, gases and their manufacture, the distillation and synthesis of liquid fuels, methods of combustion and thermal calculations, this cannot be considered excessive.

Forty-nine pages suffice for a comprehensive account of the principles underlying corrosion and its prevention, while the remaining chapters deal briefly with paints, water treatment, cements and lubrication. So brief are these that at first sight they would appear scarcely worth inclusion, but careful scrutiny reveals the fact that the author's gift of condensation is such that very few salient points have escaped notice. A little more information about modern paints would be valuable, and perhaps a future edition will contain a chapter on plastics.

This notice would not be complete without reference to the 135 diagrams, which combine small size with remarkable clarity. Finally, although the book is written for engineers, it should be read by every student of chemistry who wishes to acquire an insight into something more than the purely theoretical side of his science. H. E. W.

A Textbook of Dietetics

By Dr. L. S. P. Davidson and Ian A. Anderson; with Diet Sheets constructed by Miss Mary E. Thomson. Pp. xviii+324. (London: Hamish Hamilton Medical Books, 1940.) 10*s*. 6*d*. net.

THE unprejudiced reader will cordially endorse the appreciation of Sir John Orr, the director of the Rowett Institute for Research in Animal Nutrition, Aberdeen, when he says in the foreword of this book that the practitioner will find in it not only precise and detailed guidance for dietetic treatment, but also a scientific and lucid account of the recently acquired knowledge on nutrition on which such treatment is based. The book, which is based on courses of lectures on the physiology of nutrition and the practice of dietetics given for several years to students in the University of Aberdeen, is divided into five parts. The first consists of a general survey of the nation's diet, past and present, with special reference to the diet at various levels of income, and the experimental, clinical and sociological data on the relation of diet to health and fitness. The second part contains a clinically complete account of the physiology of nutrition. Much of the material in this section (particularly on the vitamins) is based on very recent experimental and clinical studies. The third part is devoted to diet in health, including problems of diet in childhood, pregnancy, lactation, training and war-time. In the fourth part the dietetic treatment of established diseases is discussed. The fifth part consists of tables, recipes and diet sheets, the last of which have been constructed by Miss Mary E. Thomson, sister-dietitian to the Royal Infirmary, Aberdeen.

A bibliography of recent and almost exclusively British and American literature is appended.

The eminently practical and up-to-date character of the work renders it a most desirable addition to the library of a medical man.

Diseases of Poultry

Their Aetiology, Diagnosis, Treatment and Control; with a Section on the Normal Anatomy and Physiology of the Fowl. By Ernest Gray. (Lockwood's Agricultural and Horticultural Handbooks.) Pp. x+198+16 plates. (London: Crosby Lockwood and Son, Ltd., 1940.) 9*s*. 6*d*. net.

VERY few veterinary surgeons have thought fit to write a book on diseases of poultry. Mr. Ernest Gray has done justice to the subject and is to be congratulated on his effort. A book of this size, written by one with specialized knowledge, will add to the value of any library or private bookshelf.

Naturally a good deal of the reading matter is dry and somewhat unappetizing, but this is unavoidable in a book of this character. The section dealing with specific poultry diseases is more readable than the chapters on anatomy, physiology, pathology and feeding. The book is exceedingly well illustrated and the illustrations should prove of great value to the novice when desirous of getting to the 'root of the evil'. The author makes frequent references to writings by American workers, and also refers to some recent work by British specialists.

The book would appear to fill a place between the cheap British publications on this subject and the expensive but comprehensive works recently published in the United States. H. HOWES.

Garden Science

By Dr. John Grainger. Cheaper edition. Pp. 265. (London: University of London Press, Ltd., 1940.) 2*s*. 6*d*. net.

THE re-issue of this work at such an astonishingly low price will be welcomed by all those who are familiar with the earlier edition. It is designed to meet the needs of amateur gardeners, horticultural and agricultural students, as well as pupils of matriculation standard. Characteristics of seed and vegetative propagation, plant growth and its control by the gardener, problems of plant sterility and of pest and disease control are discussed, while considerable prominence is given to descriptions of methods used for raising improved varieties of plants, the planning of experiments and of educational gardens.

THE BANANA IN CENTRAL AMERICA

I. CULTIVATION

By Prof. C. W. Wardlaw,
University of Manchester*

THE most traditional portrayal of banana cultivation is perhaps that in which an Oriental sage, sitting in pious contemplation in the shade cast by the plant, contentedly leaves it to its own devices in the knowledge that it will flourish and bear fruit for himself and for generations to come. In the early days of banana growing in Central America, the grace of Nature likewise played a prominent part in the inception of what was to become a major industry. By the middle of the nineteenth century it was known that the Gros Michel banana—now the principal variety of commerce—not only would grow but would grow marvellously on the rich soils of the Caribbean islands and mainland. It only remained to be demonstrated that the fruit, if harvested while still green and somewhat immature, could be transported to distant markets, even by sailing ship, and the stage was set for a characteristic display of American enterprise. On the fertile alluvial flats of Central America wonderful bunches of fruit were soon being produced in what was then considered large quantities, with the promise of infinitely more to come; railroads were being laid through forest and swamp; in due course the clipper gave way to the steamship, and the latter to the specialized, modern refrigerated 'banana boat'. It is a tale of more than ordinary fascination, not wanting in its record of blood and sweat, violent competition, diplomatic ingenuity, chicanery, folly and disaster, but one, be it said, telling of an agricultural industry, which, despite many vicissitudes, has enjoyed a great measure of prosperity and continued success.

The general procedure in establishing a plantation was almost incredibly simple. Large areas were roughly surveyed, sometimes, as shown by experience, very inadequately, and work on the construction of roadways commenced at once. The underbush of the virgin forest was cutlassed sufficiently to allow the laying out of the rows, the position to be occupied by each stool or plant being marked out by a stake. Suckers or 'bits' of the underground banana rhizome were then planted in holes 15 in. in diameter and 15 in. deep. The tall forest trees were then felled, creating unbelievable havoc and seemingly unconquerable confusion; but experience had shown that after two or three months the young banana plants would begin to appear through the mass of trunks, branches and twigs. As both the growth of the young plants and the decay of the forest debris take place with great rapidity under the prevailing humid tropical conditions, very soon, with occasional cutlassing of the secondary bush around the young plants, an orderly plantation is established and bunches of fruit may be reaped within the year.

In those early days of banana growing, faith in the unbounded and unending productiveness of rain-forest soils had not been shaken by crop failure or the epidemic spread of disease. Accordingly, scientific procedure had not been consciously applied to this new industry. Thus, an area might be surveyed as to its boundaries, but anything in the nature of a modern soil survey was almost invariably conspicuous by its absence. This must not be taken to infer that the early explorers for banana land did not know their job. On the contrary, like the early Spanish settlers throughout the Caribbean, they were pre-eminently successful in searching out areas possessing outstanding fertility. But extensive areas of uniformly high fertility were considerably more rare than those early land explorers could possibly assess from the limited surveys they were able to make of vast areas of swamp and rain-forest; as a result, in the ambitious planting schemes so characteristic of this new and remunerative industry, large areas were utilized which were quite unsuited to the exacting requirements of the Gros Michel banana, or which, at best, could only be profitable for a limited period.

The passage of time showed that the extensive areas of virgin land which had been taken into cultivation throughout Central America could be roughly classified into three categories: (1) poor soils on which production fell off after four to seven years; (2) intermediate soils, probably with some initial defect in fertility, which deteriorated to the point of abandonment in the course of ten to fourteen years; and (3), good soils which could be cropped continuously, in many instances without replanting, for more than twenty years. In parenthesis, it may be mentioned that some areas in the Republic of Honduras have been supporting first-class stands of bananas, without replanting, for at least forty, possibly fifty, years.

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Photographs by I. M. Smith

Fig. 1.

OVERHEAD IRRIGATION OF BANANAS IN HONDURAS.

As to what now seems such an evident necessity, the need for good drainage, more often than not this was completely neglected. Provided standing water was not actually in evidence, a plantation was considered to be sufficiently well drained. Again, where irrigation would certainly have been attended with good results, this obvious requirement was not infrequently neglected. Here then, in brief, are some aspects of banana cultivation in Central America that might have been observed some twenty to fifty years ago.

Recent years have witnessed many notable changes. The method of establishing a plantation (that is, planting, felling and brushing) is still as before. Before the planting programme is considered, however, a careful and sufficiently detailed soil survey is carried out and unfavourable areas eliminated from the scheme. The general topography of the areas is also studied in order to establish, as economically and effectively as possible, the roads, railroads and tram-lines essential to the rapid handling of fruit, while drainage schemes not only take cognizance of the needs of particular localities but also may extend to the lowering of the level of swamps, the digging of canals and the dredging of rivers. In fact, it has often been said (by the engineers) that banana growing is much more a feat of civil engineering than of orthodox agriculture. Lastly, it may be added that extensive levees are thrown up where necessary to fend off flood water from productive areas.

Such operations as those described above are typical of the advances which have been made during the past twenty years. The development of the technique of irrigation in areas where the rainfall is insufficient or badly distributed is of particular interest. Irrigation is, in fact, a major problem: it involves the construction of main channels and subsidiaries, sometimes over very considerable distances; the building of sluice gates; and in some instances the pumping of all water from wells and rivers. Lastly, a supply of sufficiently intelligent labour must be recruited to effect the surface irrigation of the plantations. It will be readily appreciated that there is more in successful irrigation than meets the eye; uniformity of application, avoidance of erosion and of waterlogging, judging irrigation cycles and quantities, costing, and, not least, adequate drainage, all being relevant to the task.

It is in respect of irrigation that one of the most interesting of innovations in banana cultiva-

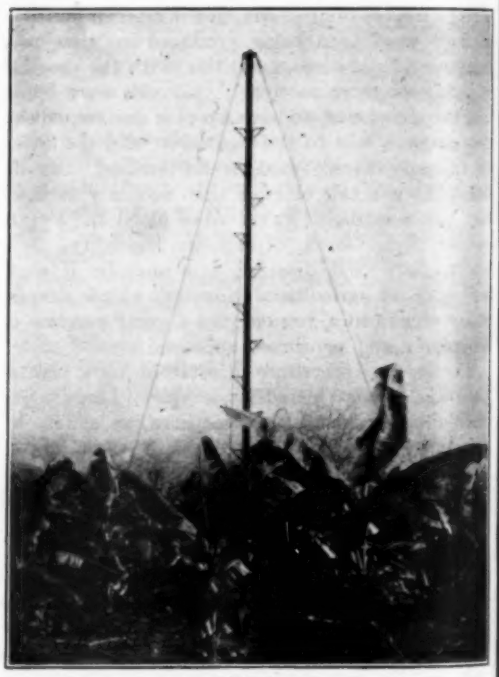

Fig. 2.

YOUNG BANANA PLANTATION SHOWING 'RISER' FOR OVERHEAD IRRIGATION.

tion is to be seen to-day. This consists in a replacement of surface by overhead applications, water being supplied to plantations by powerful pumps at the rate of 3,500 gallons a minute. The actual distribution is effected by rotating overhead nozzles or projectors, possessing an effective radius of about 70 yards, that is, each projector sprays approximately three acres (Fig. 1). The tall 'risers', that is, vertical 5-in. pipes which convey the water up to the projector nozzles, are spaced throughout the plantation as required (Fig. 2). The complete equipment, comprising a power house, two large pumps, 14-in. mains, submains and laterals, thus represents a very considerable mechanical intrusion into the leafy greenery of a banana plantation. The results achieved have been very satisfactory. As to the working method, overhead irrigation is applied continuously for several hours at a time; the duration of each application is such as to provide the equivalent of several inches of rain, thus achieving the effect of a heavy, sustained, tropical precipitation. From a point of vantage the spectacle presented by the system in operation is quite remarkable, the great arcs of water, slowly swinging round, gleaming in the bright sunlight, or being resolved into miniature rainbows.

It need scarcely be said that such extensive projects have been the subject of careful costings. Notwithstanding the initial capital expenditure, the results obtained, as judged by increased production of fruit, decrease in labour costs, etc., have been such as to justify the experiment, and the system is being extended. Factors which require consideration include the fertility and probable duration of production of the area, the status of Panama disease (*Fusarium oxysporum cubense*) and its liability to rapid spread, and the proximity of adequate water supplies for pumping.

Overhead irrigation has not only proved successful as a commercial venture, but several important results, probably not anticipated, have also accrued. Not least is the fact that this method of supplying water has greatly facilitated agricultural operations on heavy clay soils, effecting, it is thought, an actual improvement in the tilth over a period of time. Further, it has made it possible to utilize for banana cultivation soils of much higher clay content than had hitherto been deemed possible or advisable. This is a very important consideration, since clay soils have not only proved productive of good fruit, but are also 'resistant' to the inroads of Panama disease. To what extent the conquest of clay will eventually be extended by overhead irrigation, in conjunction with other innovations, is a question that cannot fail to command the attention of all interested in tropical agriculture. It will suffice to say that a high standard of production is to-day being obtained on clay soils which twenty years ago would have been omitted from any well-considered planting programme.

A characteristic of the cultivation of the Gros Michel on heavy clay soils is that the initial growth tends to be somewhat tardy, so much so that planters may be induced to think that their venture has been ill-advised and destined to failure. Experience has shown, however, that if fertilizers are applied during the first few months, the initial lag is greatly reduced; plants improve progressively with age, especially after the foliage canopy is established, and consistently good yields may be obtained. Such detailed attention to potentially productive areas is now part of the working policy of the larger companies and is in sharp contrast to the method of exploitation followed by abandonment of former days. The aim, in brief, is the highly commendable one that all sections of a farm shall be so worked in respect of fertilizing, pruning, spacing, etc., as to make for a good general standard of productiveness.

Fig. 3.
HARVESTING OF FRUIT, HONDURAS.

Reference has been made to the losses periodically caused by floods. These inundations are violent but usually of brief duration. They may prove exceedingly destructive, taking a heavy

toll not only of plants and fruit, and leaving plantations a wilderness of smashed vegetation smeared with several inches of mud, but also permanent railroads and bridges may be swept away. The path of the flood water is determined by topography, fertile areas in the river bends being especially subject to inundation and erosion. A recent experiment of very considerable interest and practical value lies in the utilization of the silt-laden flood water, which is contained and controlled by channels and levees in such a way that its burthen of earthy matter is deposited in selected low-lying areas. Each flood—and several may occur in one year—thus results in the deposition, in swampy areas, of several inches of friable and fertile top soil, eroded from higher up the valley. In a surprisingly short space of time—a few years at most—hitherto valueless low-lying areas are so built up that they can be drained and planted with bananas. This useful work is now being undertaken on a not inconsiderable scale.

In the banana lands of the Ulua River (Republic of Honduras) such reclaimed areas can be seen to-day. They are supporting excellent stands of young plants, and the incidence of Panama disease was, as observed by me at the beginning of 1940, negligible. Such innovations are of the greatest significance in the agricultural development of Central America. They mark the transition from the impermanence and rough-and-ready exploitation of other days to the rational utilization of natural resources and to that permanence which should result from a system which aims at the maintenance of a high standard of productivity in favourable localities. To the consumer on distant markets, such preparations for the future also bring the assurance that there will be no abatement in the supplies or quality of the product to which he has become accustomed.

Some fifteen to twenty years ago, with the abandonment of vast areas on account of Panama disease and deterioration of fertility under continuous single crop cultivation, the question was frequently mooted as to the fate of the banana industry when all the good virgin areas became used up. The question is still asked and it may now be answered. So far as Central America is concerned, there seems no reason for supposing that production will seriously decline for many years to come. In recent years, there has not only been adequate production on the major properties, but actually over-production of bunches of the first quality. Extensive areas, mapped for banana growing, have not yet been touched, other new and highly productive areas are being developed on a very conservative scale, and, as indicated above, existing plantations are not only being maintained in first-class condition but also are being daily added to by the control of flood water.

To the agriculturist as to the layman, the spectacle of a modern banana division, comprising some sixty square miles under cultivation, with surface and overhead irrigation provided where necessary, and supplied throughout with a pipe-line system for the application of Bordeaux Mixture (used to control Cercospora leaf disease), is one that engenders confidence for the future. To those who have been responsible for such notable achievements, and for much courageous experimentation on a grand scale, great credit is due.

THE BIRTH OF GLACIAL GEOLOGY*

By Dr. William J. McCallien
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THE year 1840 will always be remembered as one of outstanding importance in the annals of geology. So far as Great Britain is concerned, glacial geology was born in 1840 with the visit to this country of Louis Agassiz. Glasgow will always be associated with this event, for Agassiz attended the tenth meeting of the British Association which was held there in the summer of 1840. At the meeting he took the opportunity of proposing the revolutionary theory "that at a certain epoch all the north of Europe, and also the north of Asia and America, were covered with a mass of ice". Woodward, in his "History of Geology" (1911, p. 121) has said: "Since the days of William Smith no more momentous, and, as time has proved, no sounder, explanation of a vast and difficult problem had been given in geological science."

Agassiz wrote: "In the early part of the summer of 1840, I started from Switzerland for England with the express object of finding traces of glaciers in Britain. This glacier-hunt was at that time a somewhat perilous undertaking for the reputation of a young naturalist like myself, since some of the greatest names in science were arrayed against the novel glacial theory. . . ."[1]

* Part of an address to the Geological Society of Glasgow on December 14.

Towards the end of this essay Agassiz continues: "Of course the ancient glaciers of Great Britain were far more difficult to trace than those of Switzerland, where the present glaciers are guides to the old ones. Nevertheless, my expectations were more than answered. The first valley I entered in the glacial regions of Scotland was barred by a terminal moraine . . . the surface of the country [was] polished, grooved, and scratched, as in the region of existing glaciers, presenting an appearance corresponding exactly to that described elsewhere . . .". The satisfaction which Agassiz experienced on this occasion was probably equalled only on the excursion which he made from the steamer on first setting foot on the American continent in 1846.

Before considering the events of 1840 further, let me give a very brief account of the state of knowledge regarding superficial deposits and surface phenomena in general before that time. It is not my purpose to enter into details concerning the history of glacial research. Such a summary will help us to appreciate the far-sighted nature of Agassiz' conclusions.

As Agassiz himself said, it was at that time much easier to believe in the former extension of ice in the Alps than in the glaciation of the British Isles. We turn to the Alps, therefore, for information about glaciers, and we find that so far back as 1787 Kuhn believed in the former extension of the Grindelwald Glacier. Later, de Saussure, Hugi, Venetz, and Charpentier all emphasized the significance of valley moraines standing outside the limits of existing glaciers. In 1829, Venetz suggested the extension of the ice far beyond the mountain valleys to the great erratic blocks which lie on the slopes of the Jura Mountains. The existence of these enormous granite blocks had been pointed out by de Saussure, but the first actual suggestion that they were ice-carried came from James Hutton. Hutton never saw the boulders himself; he knew of them only through the writings of de Saussure. Before this it was generally believed that they had been transported by a great deluge, but according to Hutton's philosophy "general deluges form no part of the theory of the earth". Hutton's suggestion, however, was forgotten.

Hutton's famous disciples, James Hall and John Playfair, were more fortunate than their master, for they studied the granite blocks in the field. Hall followed de Saussure in attributing their transport to a gigantic wave. Playfair, confronted in particular with a block weighing some 2,520 tons at a distance of seventy miles from its source and with its corners conspicuously unrounded, came to the conclusion that "A glacier is the only agent we now see capable of transporting them to such a distance, without destroying that sharpness of the angles so distinctive of these masses"[2].

Venetz rediscovered the solution to the problem of the erratics and he was followed by Charpentier in 1834. Venetz and Charpentier may be considered the real founders of glacial research. Agassiz went further than both in his observations and from these he made deductions undreamed of by his masters.

It was under the personal guidance of Charpentier that Agassiz began his investigations of the Rhone erratics in the summer of 1836. This study, coupled with his knowledge of the literature, in a very short time led him to his great theory. In the winter of 1836–37 he lectured at Neuchâtel on the Ice Age and propounded the theory that the ice originally extended over the Alps as far as erratics, polishing, and striæ occur. Agassiz soon realized that the former extension of the Swiss glaciers must have resulted from some general lowering of temperature. In 1840 he published an account of glaciers in general, and in this he propounded the glacial theory. At that time he knew northern Europe only from the writings of others, and he was familiar with the striæ, moulding, and erratics of the Edinburgh district through the published descriptions of James Hall. It only remained for him to test his theory in the British Isles.

There is no doubt that up to the time of Agassiz' visit the superficial phenomena of Great Britain were looked upon as the work of a great deluge usually identified with the Biblical flood. The nearest approach to glaciers was the suggestion of iceberg-carry proposed by some writers.

Dr. Buckland of Oxford, one of the most influential writers of the 'golden age of geology', was the great champion of the geological proofs of the Biblical flood. At his inaugural lecture at the University of Oxford in 1819, Buckland announced that a universal flood is proved so decisively "that had we never heard of such an event from Scripture or any other authority, Geology of itself must have called in the assistance of some such catastrophe to explain the phenomena of diluvial action".

By 1837, however, Buckland was wavering in his support of the flood to the extent that he wrote that "This important point, however, cannot be considered as completely settled till more detailed investigations . . . shall have taken place." By this time Venetz, Charpentier, and Agassiz had made great strides with the interpretation of the surface features and deposits of the Alps. Glacial action in the ice-free valleys and mountain slopes were recognized by signs which Buckland realized were identical with the very phenomena he knew so well at home, and

which he explained by a great deluge. He went to Switzerland in 1838 to visit Agassiz and see the evidence for himself. Of this visit Sollas has written, "a few days' personal investigation sufficed to convince Buckland of the truth of Agassiz' opinions". At the same time he must have been quite convinced in his own mind of the former glaciation of Britain, for he persuaded Agassiz to visit this country in 1840.

Let Agassiz tell the story in his own words: "Only one of my older scientific friends in England, a man who in earlier years had weathered a similar storm himself, shared my confidence in the investigations looked upon by others as so visionary, and offered to accompany me in my excursion to the North of England, Scotland, and Wales. I cannot recur to that delightful journey without a few words of grateful and affectionate tribute to the friend who sustained me by his sympathy and guided me by his knowledge and experience.

"For many years I had enjoyed the privilege of personal acquaintance with Dr. Buckland, and in 1834 when engaged in the investigation of fossil fishes, I had travelled with him through parts of England and Scotland, and had derived invaluable assistance from his friendly advice and direction. . . . A few years later he visited Switzerland, when I had the pleasure of showing him, in my turn, the glacial phenomena of my native country, to the study of which I was then devoting all my spare time. After a thorough survey of the facts I had collected, he became satisfied that my interpretation of them was likely to prove correct, and even then he recalled phenomena of his own country, which, under the new light thrown upon them by the glacial phenomena of Switzerland, gave a promise of success to my extraordinary venture. We then resolved to pursue the inquiry together on the occasion of my next visit to England; and after the meeting in Glasgow of the British Association for the Advancement of Science, we started for the mountains of Scotland in search of traces of the glaciers, which, if there was any truth in the generalizations to which my study of the Swiss glaciers had led me, must have come down from the Grampian range, and reached the level of the sea, as they do now in Greenland"[2].

The results of the Scottish tour were communicated to the Geological Society of London in November, 1840[4]. Sir Archibald Geikie has said that the views expressed by Agassiz and Buckland "were violently opposed and sarcastically ridiculed at the Society's Meetings when they were communicated"[5].

There is only an abstract of Agassiz' Glasgow address in the Report of the British Association. It seems to have covered much the same ground as was described in detail in the same year in "Études sur les Glaciers". At the Glasgow meeting he propounded the theory "that at a certain epoch all the north of Europe, and also the north of Asia and America were covered with a mass of ice. . . . "From his studies of the Alpine glaciers Agassiz was led to recognize the former existence of ice in Britain. Hutton's own doctrine that the present is the key to the past partly explains why he and Hall failed to recognize glacial phenomena in Scotland and why it was left to one familiar with modern glaciers to make the discovery.

We cannot close this account of 1840 without mention of James Smith of Jordanhill, who was president of the Glasgow Geological Society during 1851–67. Smith read a paper at the Glasgow meeting of the British Association in 1840 in which he pointed out the presence of shell-beds forty feet above sea-level and containing shells of arctic species now extinct around our shores. James Smith was the first observer to bring forward convincing evidence of the lowering of general temperature of our latitudes. He was the pioneer of glacial palæontology. Another of Smith's claims to fame is the share he had in launching A. C. Ramsay upon a scientific career. Ramsay exhibited his model, map, and sections of Arran at the Glasgow meeting of 1840, and it was as a result of this work that he joined the Geological Survey, of which later he became director general.

Bailey has aptly said that the glacial theory, launched in 1840, "registered an attack rather than a victory" and that for years to come it "seemed to have been repulsed". It was not until 1863 that land ice finally displaced icebergs and succeeded in claiming the greatest share in the glaciation of our country. In that year Sir Archibald Geikie published his famous paper "The Glacial Drift of Scotland"[6].

Although Geikie's paper of 1863 brought an end to the period of stagnation in glacial research that followed the announcement of the glacial theory, two important papers were published in the previous year: Ramsay's account of the glacial origin of rock-basins[7] and Jamieson's conversion from floating ice to land ice as a result of his tracing of ice-moulding uphill from Loch Fyne westward towards the Atlantic[8].

[1] "Geological Sketches", Second Series (1876).
[2] "Illustrations", 349 (1802).
[3] "Geological Sketches", Second Series, 3–5 (1876).
[4] *Proc. Geol. Soc.*, **3**, 327–32, 332–7, 345–8; also Lyell, 337–45 (1840–41).
[5] Pres. Add. to the Geol. Soc., *Q. J. Geol. Soc.*, **64**, 92.
[6] *Trans. Geol. Soc. Glasgow*, **1**, Pt. 2, 1–190 (1863).
[7] *Q. J. Geol. Soc.*, **18**, 185–204 (1862).
[8] *Q. J. Geol. Soc.*, **18**, 164–84 (1862).

OBITUARIES

Dr. Cresswell Shearer, F.R.S.

DR. CRESSWELL SHEARER, who died at Cambridge on February 7, after a brief illness, will be remembered as one of the most interesting personalities in the ranks of British zoologists.

As a young man Shearer took a medical degree at McGill University, but his main scientific interests lay in the field of experimental embryology. He spent much time at Naples at a period when the Stazione Zoologica was perhaps at the zenith of its fame. There he met many of the great figures of late nineteenth century biology, and his recollections of this period were afterwards a constant source of delight and instruction to his own Cambridge pupils. In 1910 he settled in Cambridge, and shortly afterwards was appointed the first of a series of University lecturers in experimental zoology. The next decade was a period of active and productive research. They were also, however, years of unusual inspiration to students. His lectures were almost invariably unorthodox in presentation, if not in substance, but they gave a real insight into contemporary biological thought and threw into relief the lines along which future progress seemed likely to come.

Prior to the War of 1914–18, Shearer had published a number of important papers on the development of trochosphere larvæ and on sex determination in Dinophilus. In 1913 the *Philosophical Transactions of the Royal Society* contained the well-known monograph on "The Experimental Hybridisation of Echinoids", which was the result of Shearer's work in collaboration with W. de Morgan and H. Munro Fox. This work was carried out at Plymouth, where many of his pupils followed him in the summer months of each year. During the War, he returned to medicine and worked in the west of England. Here began many years of happy married life.

Shearer was elected a fellow of the Royal Society in 1916, and in 1918 returned to Cambridge to carry out a series of important researches on the effect of fertilization on the metabolism of the eggs of sea urchins. He showed, for the first time, that spectacular changes in oxygen consumption occur for a few seconds after the spermatozoon has entered the egg.

Shearer's versatility was perhaps one of the most characteristic features of his University career. He worked first in the Department of Zoology, then in those of Pathology, Physiology, and finally Anatomy, keeping in close contact with the younger research workers in all these and other laboratories. For several years he held the post of University lecturer in embryology in the Department of Anatomy. On his retirement from University work, he returned once more to the Zoological Department, much to the pleasure and advantage of the Department.

Apart from his biological interests, Shearer was a man of wide general learning. His knowledge of medieval Italian architecture was profound, and in 1935 he published "The Renaissance of Architecture in Southern Italy". It is to be hoped that his later work will also be made available to those interested in this field of learning. His ability as an artist and his enthusiasm for photography were not only of great value to him in both his scientific and literary work, but also gave very considerable pleasure to his friends.

Shearer was a man of rather retiring disposition, but once the thin crust of his reserve was broken, he revealed a warm-hearted and most generous nature. His memory will not readily fade. J. GRAY.

Dr. J. G. Priestley

BY the death of John Gillies Priestley, which occurred on February 9 at the age of sixty-one, the School of Physiology at Oxford has suffered a loss which it can ill afford, especially at this critical time when university education is faced by endless difficulties arising from the War. He was, it is true, somewhat reticent by nature, but those who knew him best gained in his friendship something that they prized. A man of great personal charm, generous to those in need, he was always ready to interrupt his own work to give help and advice to any who sought it. With a balanced judgment on the work of others, he was hypercritical of himself and modestly diffident of his own powers. Meticulously accurate in his experimental methods, no trouble was too great for him to take in his research work, and in his teaching he always tried to inculcate into his pupils some of his own gift for accurate observation and attention to detail. With a quiet courage and determination that was characteristic he fought against ill-health that told more and more upon him as the years passed, publishing his final paper in December 1940, and resigning his readership only a few weeks before his death when he knew that he had no longer strength to fulfil the duties of his office.

Priestley was educated at Eton and gained an open scholarship at Christ Church in 1898. It was whilst reading physiology at Oxford that he became acquainted with John Haldane, whose friendship was to have a great influence on his future career. As soon as he had taken his degree in 1902, he joined Haldane in an investigation which resulted, in 1905, in the publication under their joint authorship of that remarkable paper on the "Regulation of the Lung Ventilation" which was to play so large a part in the development of physiological knowledge. Leaving Oxford he then went to St. Bartholomew's Hospital to complete his clinical studies. After gaining his medical qualification he became house physician to Sir Wilmot Herringham, whose high opinion he won. After working for a year with Falta in Vienna he returned to St. Bartholomew's to take charge of the new Laboratory of Chemical Pathology which had just been opened, but within two years he developed tuberculosis of the lungs and had to go

to Davos for treatment. The disease was checked, but pulmonary fibrosis left him with a legacy of ill-health, which was all the more tragic to a man who had a great interest in out-door sport and big game shooting, and had been a distinguished oarsman at Oxford.

Returning to Oxford in 1913 he began a series of investigations into the part played by the kidneys in the regulation of the composition of the blood, but this work was soon interrupted by the outbreak of the War of 1914–18. He volunteered at once, and was given a commission in the R.A.M.C. on September 1, 1914. Serving in France and Belgium he was in the following year awarded the Military Cross and was mentioned in despatches. He was wounded at Neuve Chapelle. Later in the War he was associated with Haldane and Meakins in an investigation into the after-effects of war-gas poisoning. When peace came he was appointed reader in clinical physiology at Oxford. His further investigations included work on various aspects of the physiology of respiration, on the function of the kidney, on some problems of general metabolism, and, more recently, he was engaged on a critical examination of methods for ascertaining the output of the human heart. He was again, and most appropriately, associated with Haldane as joint author of a new edition (1935) of Haldane's book "Respiration". With a clear appreciation of the relationship of physiology to medicine he was largely responsible for initiating a practical course of human physiology in the Final Honour School of Physiology, which led to the publication of "Human Physiology; a Practical Course", now in its second edition, of which he was joint author. For the Physiological Society he prepared a subject index of the first sixty volumes of the *Journal of Physiology*, and he succeeded John Mellanby in the editorship for a few years of *Physiological Abstracts*, a task in which his expert knowledge of the international decimal system for the classification of scientific papers proved of great service.

He leaves a widow, and a son, Major Charles Priestley.

C. G. DOUGLAS.

Dr. Alexander Bowman

AMONG the men of science who have guided fishery research in Scotland, and they form a distinguished company, Dr. Bowman was marked by a grasp of the practical problems of the fisheries and of the scientific efforts which must lie behind the solution of these problems.

Yet scientific work was not his earliest notion of a career. He began by helping his father in a prosperous business in Aberdeen, and then proceeded to take the normal training for a teacher at the Free Church Training College in that city. It was after these first essays that he decided to enter the University, and to study for a degree in science. He graduated in the University of Aberdeen with distinction in zoology, and was awarded the Fullerton research scholarship in natural science, but before the completion of its tenure he resigned on being appointed naturalist to the Fishery Board for Scotland.

There he worked in collaboration with Sir D'Arcy Thompson, scientific member of the Fishery Board, and his early activities were centred upon the research steamer *Goldseeker* and the amassing of enormous collections made during the periodic voyages of that vessel, which were to help in explaining the movements of waters, the changes of salinity, the distribution of food materials, and thus to interpret the movements of the fishes themselves. Later he applied himself with great success to the solution of practical fishery problems, such as the elucidation of the enormous fluctuations in fish supplies, the forecasting of future yield, the effect of the size of mesh in influencing escapes of undersized fish, and so on. During these years he worked almost single-handed and with great devotion, spending month after month at sea in the stormy northern waters, laying the foundation of his vast knowledge of the fisheries in their scientific and practical aspects. In 1908, Dr. Bowman obtained the degree of D.Sc. at the University of Aberdeen for a thesis containing some of his pioneer work in the experimental study of fishing methods, notably on the otter trawl and its effect on the stocks of fish. His experience of fishery research was widened by periods of study in Denmark and Germany.

On the sudden death of Mr. Nelson, who had just succeeded Dr. T. Weymss Fulton as scientific superintendent of the Fishery Board for Scotland, Dr. Bowman was appointed to fill the post in 1923. In this position he developed his earlier researches and enlarged the scientific staff of the Board. An excellent example of the value of his methods is to be seen in his work upon the haddock, which has formed the foundation of the most thorough-going knowledge of one of our most important food fishes. He considered that one of his greatest honours was his appointment in 1925 as chairman of the Northern North Sea Committee of the International Council for the Exploration of the Sea, but the choice was not surprising, for his colleagues at home and abroad had the greatest respect for his knowledge and judgment, and he was properly regarded as one of the best fishery experts of his time.

Dr. Bowman's training as a teacher was made use of by the University of Aberdeen when it appointed him lecturer in the scientific study of fisheries, and in Aberdeen and the surrounding district he conducted classes in marine zoology for teachers and delivered popular lectures on natural history. In 1933 ill-health compelled him to resign from his post, and a lingering illness ended his life on January 14, when he was in his sixty-fifth year.

WE regret to announce the following deaths:

Prof. F. A. P. Aveling, University professor of psychology in King's College, London, on March 6, aged sixty-five.

Miss Ethelind Gardiner, for thirty-five years secretary of the Royal Society for the Protection of Birds, on March 1.

Sir George Grierson, O.M., K.C.I.E., the Oriental scholar and compiler of the "Linguistic Survey of India", on March 7, aged ninety.

NEWS AND VIEWS

NATURE and the War

UNDER the title "An American Message", we publish on p. 329 of this issue a complimentary note from the managing editor, associate editor and staff of the *Bell Laboratories Record*, the monthly journal of the Bell Telephone Laboratories, Inc. These Laboratories, which form one of the largest industrial research centres in the world, are well known to physicists and engineers for their research on electronic physics, chemistry, magnetism, optics, radio, applied mathematics, speech and hearing, and generation and modulation of electrical currents. Such a communication is very encouraging, and no doubt British readers will receive it with pleasure. This American message is merely a reflexion of the main body of opinion in the United States, finally endorsed by the signing of the Lease and Lend Bill by President Roosevelt on March 11, after it had been approved by the House of Representatives by the overwhelming majority of 317 to 71.

The letter is one of a large number already received, though this is the first from a group of men of science —the others having been sent by individuals. NATURE is still carrying on despite the many and varying difficulties caused by the War and the air attacks on London. The subject material has, perforce, been modified, especially in the case of the physical sciences, since certain material must obviously be withheld for defence reasons. Furthermore, little material can be expected from countries outside the British Commonwealth and the Americas. This has caused a reduction in the correspondence columns, and the international character of NATURE is thus temporarily impaired. This is regrettable, though it is difficult to conceive of any other situation, since even if communications abroad were still open between Great Britain and those countries at present closed to postal communication the editors of NATURE would still pursue vigorously their policy of gathering the forces of science to help in the fight against aggression and against those at present repudiating and even suppressing truth and encouraging the propagation of falsehood.

Though situated in an area which has certainly had a share in the wanton destruction resulting from indiscriminate bombing, we are glad to say that, so far, the offices of NATURE have suffered nothing but a few broken windows and occasional interruption of of work caused by the proximity of delayed-action bombs. In any event, arrangements have been in existence for some considerable time for NATURE to carry on elsewhere in the unhappy event of its present home becoming uninhabitable for any length of time.

War and Scientific Research

IN an article in the *Quarterly Review* of January on the effect of the War on scientific research, Mr. J. M. Watson emphasizes the extent to which fundamental, long-range research is interrupted by the necessity of concentrating effort on the solution of urgent day-to-day problems and investigations related directly to the war effort. The whole course of hostilities is profoundly affected by pure research, pursued in peace-time for no ulterior motive; meteorology and wireless telegraphy provide outstanding examples. But in spite of the great volume of special research instituted for the prosecution of the War, the general effect upon scientific advance is one of stultification. Moreover, it is the application of known principles rather than the discovery of new ones which provides the solution of urgent problems, and the reduction or cessation of pure research in war-time not only retards the progress of science but also interrupts its stimulating and fertilizing effect on all scientific work, including *ad hoc* research. Mr. Watson also refers to the lack of co-ordination between scientific advisers and executive authorities which hampers progress, as well as to the danger which attends the absence of a scientific outlook in circles wielding political and executive power. Moreover, the scientific outlook and the results of scientific research must play an even bigger part in post-war reconstruction than in the War itself.

The problems which confront the research worker in war-time are placed by Mr. Watson in six main groups. The first of these includes the medical and surgical problems, whether of epidemic disease, the treatment of wounds, the treatment or prevention of secondary infections of wounds, or the investigation of means of promoting speedier healing. The second group embraces problems relating to the supply of raw materials, on which so much German effort has been concentrated. The War has given a tremendous stimulus to industrial research in the use of synthetic plastics. The third group includes problems relating to the production or improvement of weapons of war, including the various precision instruments and such problems as those of camouflage, where Mr. Watson stresses the importance of the psychological factor. In the fourth group of problems, relating mainly to the civilian population, which have been comparatively neglected until very recently, the difficulties are concerned with social research and education and with effective control of vested interests, rather than with scientific research. This group includes such matters as agricultural research, nutrition, the nervous disorders arising from aerial bombardment and like aspects of public health. Problems summarized under the heading of public relations, notably propaganda and morale, and the scientific investigation of matters bearing on industrial efficiency, such as hours of work, ventilation, lighting, noise, etc., comprise the fifth group, while in the sixth group are to be placed the entirely new set of investigations arising from the introduction of air raid precautions.

The National Day of Prayer

HIS MAJESTY THE KING, having expressed a desire that March 23 should be observed as a national day of prayer, statements have been issued by leaders of religious bodies in Great Britain. Dr. Lang, the Archbishop of Canterbury, after observing that "we are now approaching or entering a critical stage in the tremendous struggle", considers it most fitting that the King, as head of the nation, "should once again call it to renew the acknowledgement of its need of God and dependence on Him", and to pray for "His forgiveness of all that has been amiss in our national life, for strength and guidance in the stern and testing days which may be coming, and, if it be His will, for good success". The Primate observes also that with such prayers it is right that "we should offer thanksgivings for mercies already received", alluding to "the wonderful way in which we have escaped the dangers which surrounded us last summer and autumn". His Eminence Cardinal Hinsley, Archbishop of Westminster, declares that, "the stern trials that face us call for the light and strength which God alone can give. Moreover, the mercies we have received in answer to prayer should cause us to lift up our hearts in thanksgiving to 'the God of all consolation' ". His Eminence also urges the faithful "to pray that this deadly strife among nations may speedily end in a true peace based on justice and love".

The statement issued by the Rev. Sidney M. Berry and the Rev. S. W. Hughes, on behalf of the Free Church Federal Council, appeals to Free Churchmen throughout the country to observe the Day of Prayer. "The struggle in which we are now engaged they declare, "will never issue in the kind of world we want to see by relying merely on the power of material weapons and resources. Our supreme need is for God's guidance and strength". They urge that the day of prayer be freed "from any false ideas that prayer is a kind of magic, or that we only turn to God when we are at our wit's end". To be truly observed the day must mean "a dedication of ourselves through days of peril into those other and happier days of victory and peace, when dangers of another kind may come to us". The Chief Rabbi, Dr. J. H. Hertz, in his statement declares that "his Majesty's Jewish subjects will loyally obey the royal summons", using "supplications to our Father in Heaven for strength and guidance, as well as prayers of thanksgiving for the mercies and victories hitherto granted to the forces of freedom".

Railways under War Conditions

THE vigorous defence of the operation of the railways under war conditions, which Lord Stamp offered in his chairman's address at the annual general meeting on March 7 of the London, Midland and Scottish Railway Company, contained an interesting reference to the work of the Company's Research Department, the very great value of which in solving war-time problems he emphasized. Such problems as substitute materials, salvage, air raid precautions and black-out could only be solved quickly and effectively by scientific methods. Lord Stamp referred particularly to the work of the Research Department on treatment of the windows of signal boxes without interfering with clear vision, which had proved so effective that in the boxes so treated not a single man had been injured by glass splinters; the importance of this in maintaining confidence and operating efficiency can be imagined. With the lighting section, the Research Department has also contributed to the development of scientific methods, enabling a combination of safety from observation with the best permissible lighting to be used in dealing with the innumerable problems of lighting the black-out in goods sheds, marshalling yards and elsewhere. Lord Stamp's spirited reply to criticism, which has sometimes been somewhat irresponsible and carping, made it clear that the handicaps on the railways and the strain on their reserves could be mitigated by intelligent forethought on the part of the Service Departments. It may be hoped that his indictment of want of foresight or worse will not escape the notice of that invaluable watch-dog over administrative weaknesses—the Select Committee on National Expenditure.

British Medical Students in the United States

THE Minister of Health, replying in the House of Commons to a question by Prof. A. V. Hill, said that he was aware that an offer had been received from the Rockefeller Foundation in New York to undertake and provide for the clinical training and maintenance of selected British medical students in medical schools in the United States of America and in Canada. A committee to select students has been set up in Great Britain under the chairmanship of the Vice-Chancellor of the University of Manchester, Prof. J. S. B. Stopford, and consisting of Prof. H. R. Dean (vice-chairman), Prof. H. W. B. Cairns, Mr. H. L. Eason, Prof. G. E. Gask, Mr. G. F. Gibberd, Dr. A. M. H. Gray, Prof. A. V. Hill, Surgeon Rear Admiral J. W. McNee, Sir Walter Moberly, Sir Franklin Sibly and Mr. W. B. Brander, of the Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (secretary). The first group of students will leave for America as soon as possible.

The Rockefeller Foundation's grant is of 100,000 dollars, and will suffice for about twenty-five studentships, providing cost of tuition and maintenance for two or three years. It comes at an opportune moment, when clinical studies in Great Britain are of necessity being continued under difficulties imposed by shortage of teaching staff, many of whom are on active service, and by damage caused to some of the leading hospitals by enemy action. The selected students will go to various universities in the United States and Canada, where they will be able not only to complete their medical studies, but also to obtain valuable experience of practice and research in North America. This generous grant is yet one more demonstration of the desire to help and practical interest of the United States in the preservation of European standards of life.

Economy in Drugs

A MEMORANDUM on "Economy in the Use of Drugs in War Time" by the Therapeutic Requirements Committee of the Medical Research Council has been issued as an official publication. It is based on the provisional lists circulated last autumn, a summary of which appeared in NATURE (October 12, 1940). These lists have been thoroughly revised and greatly extended. Some five hundred drugs are classified into three groups: (1) essential or readily available; (2) essential for certain purposes but in the use of which strict economy should be observed; and (3) not essential. By a recent Defence Regulation, the Ministry of Health was empowered to make Orders authorizing the replacement of scarce drugs by alternatives having substantially the same therapeutic action; it is understood that the Medical Research Council is the body which advises on essential and non-essential medicinal substances, and consequently this memorandum is of no little importance, since it may be taken that it gives at least some indication of the drugs which may be the subject of Orders. In the meantime, medical men are expected to avoid the prescription of drugs in classes 2 and 3 so far as possible. Of more permanent interest is an appendix to the memorandum, consisting of the names of drugs which, in the view of the Medical Research Council, should be produced in the British Empire and should be encouraged.

Post-War Building and Planning

SOME aspects of the problem of post-War building are discussed in *Electrical Industries* of February. It seems clear that some limitation of the size of our future towns and cities will have to be seriously contemplated. This, in turn, will inevitably give rise to many indirect problems of a complicated nature. From the point of view of electrical supply, no matter what type of building in our reconstructed areas is finally decided on, the vast potentialities for the extended use of electricity can readily be visualized; especially when we bear in mind that the work of reconstruction will not only be confined to housing, but will also embrace industry and its location. The general plan of reconstruction will probably take into consideration, besides the bombed areas, those slum clearance schemes held in abeyance for the duration of the War. It would be dangerous to encourage the public to expect too much from post-War reconstruction, especially in its early stages, and already a warning has been issued by Lord Reith on this subject. So far as electric supply authorities are concerned, many of the pre-War development schemes which have necessitated, or will necessitate, the laying down of new sub-stations and networks to cater for future requirements may have to be drastically revised. One of the most important points is that when normal times return and the preliminary surveys are made, the electric supply industries, assisted by such bodies as the Electrical Development Association, the British Standards Institution and the British Electrical and Allied Industries Research Association, should be in a position to place immediately before the appropriate authority the electrical position in its entirety.

Air Raid Damage to the London Museum

THE damage sustained by the London Museum has been confined almost entirely to its glass. The major portion of the windows on the south front, the glass in the lantern of the Main Hall and that of the lantern in the Costume Gallery, which was of ground-glass, decorated with allegorical figures, have been destroyed. The matchless gilded ceilings and the painted panels have, however, escaped damage, and even the original chandeliers and candelabra have been in the main uninjured. Before the outbreak of war, most of the collections were removed from the building, only some of the more cumbrous exhibits and models being left in the basement, and a small collection of less important duplicate material being retained for special exhibitions, and for the illustrations of a course of lectures, which was given in the early part of last year. The collections are thus intact, even the material remaining in the building being unharmed.

Alcohol and Vitamin A

IN a recent issue of *Science* it is claimed by Drs. Samuel W. Clausen, Burtis B. Breeze, William S. Baum, Augusta B. McCoord and John O. Rydeen, of the University of Rochester School of Medicine and Dentistry, that taking alcohol raises the vitamin A content of the blood in men as well as dogs. 'Before-and-after' tests were made on ten persons taking alcohol in the form of mixed drinks as desired. In every case the amount of vitamin A in the blood was increased after the drinking. The increase was relatively slight in most cases but was remarkably large in one person who had a high level of vitamin A in his blood before the drinking. Night-blindness is one of the chief signs of lack of this vitamin, although it is required for health of other parts of the body besides the eyes, and for normal growth of children.

Tests of ability to see in the dark, one method of determining whether a person is getting enough vitamin A, made after drinking, showed unaccountably short recovery time in dark adaptation. Dr. L. B. Pett, of the University of Alberta, who made this observation, suggested that the reason was the mobilization of vitamin A from its storage place in the body, presumably the liver, to the blood, which would distribute it to other parts of the body including the eyes. The vitamin A tests reported by the Rochester scientific workers were made on the blood, not the eyes. They also believe that the increase in blood vitamin A after alcohol is due to a mobilization of the vitamin from other tissues. They suggest that this might form the basis of a test for vitamin A storage in the body.

Alcohol and Brain Metabolism

IN a recent paper (*Amer. J. Psychiat.*, 97, 385; 1940), Drs. Walter W. Goldfarb, Karl M. Bowman and Joseph Wortis of the Psychiatric Division, Bellevue Hospital, New York, report the effects of ethyl alcohol on the metabolism of the brain in ten patients admitted to hospital presenting the clinical picture of acute alcoholic intoxication. The estimation of cerebral metabolism was based on the difference between the concentrations of various substances in the arterial and venous blood of the brain. The arterial blood was taken from either the brachial or femoral arteries, and the venous blood from the internal jugular vein. During the condition of acute intoxication the cerebral uptake of oxygen was diminished in six cases and within normal limits in four, while after recovery the uptake of oxygen was within normal limits in all cases.

Whale Marking

AFTER a considerable amount of experimenting the Discovery expedition evolved a satisfactory device for marking whales, in the form of a stainless steel tube 10 in. long that can be fired from a 12-bore gun. In the four seasons 1934–38 a total of 5,219 whales of six species was considered to be satisfactorily marked. G. W. Raynor (Discovery Reports, 19; 1940) describes the methods of marking, the data provided by the marks so far returned and discusses their significance. Of the three main species to be marked, the Blue, the Fin and the Humpback, there have been 187 returns out of 1,513 marked. This is not a large number, and it will obviously be increased in the course of time; but in view of the present conditions it was considered advisable to publish the results so far obtained. The Blue stock is being depleted faster than the Fin stock; but the Humpbacks are suffering most heavily. Blue whales round South Georgia are not a stationary group but move west towards the end of the whaling season. Similarly, Fin whales, although they may remain longer, move off to the south. The Humpbacks probably have an annual migration from the Antarctic to the north-west coast of Australia and to Madagascar. They also tend to remain more together and so do not exhibit the dispersal shown by the other two stocks. The dispersal is not quite so marked in the Fins, so that there appear to be "provinces" within which there is considerable movement but between which there is very little exchange of stocks.

The Heating of Buildings

AT a meeting of the Newcomen Society, held at the Institution of Civil Engineers on February 12, Mr. A. F. Dufton read a paper entitled "Early Application of Engineering to the Warming of Buildings" in which he reviewed the improvements of fire-places and stoves, and the introduction of heating by steam and hot water. The old open fire-place has long been recognized as a most wasteful and inefficient means of heating a room, and it was to economize fuel that Franklin in 1745 introduced the Pennsylvanian fire-place by which he reckoned to save five-sixths of the fuel. Many years before Franklin, a French physician, Nicholas Gauger, had published a work, "La Mécanique du Feu", and had described the ventilating fire-place. In his work he referred to a form of such fire-place which had been installed in the library of the Louvre. Steam heating was used by Watt as early as 1784, but his tin-plate radiation was not satisfactory. Sir John Leslie's experiments in radiant heat had not then been made. Among the pioneers of heating Rumford was one of the most successful, and in his writings pointed out the necessity for double-windows to rooms. Strutt of Derby was another pioneer of this time. Heating by hot water was used in France in 1777 by M. Bonnemain for his chicken incubators, and to Perkins we owe the use of the high-pressure hot-water system. Another improver of stoves was Dr. Neil Arnott, who in 1854 was awarded the Rumford Medal of the Royal Society.

Lubrication Technique

EXPERIMENTS for determining both the qualities and methods of application of lubricants are sometimes vitiated by being carried out too quickly. An oil behaves quite differently, for example, when introduced in a properly run-in bearing and when used in one that has been recently assembled. A very similar case occurs with oil containing colloidal graphite. This oil when used in a short-duration test may give results which are misleading. It is claimed by the manufacturers of a product of this nature, Messrs. E. G. Acheson, Ltd., Thames House, Millbank, London, S.W.1, that the particles of graphite in colloidal suspension form a slippery surface on the working faces of the parts in contact, but that, due to the stable nature of the lubricant, an appreciable time may be required for the particles to become adsorbed on the surfaces. Research has shown that the rate of adsorption on a metallic base depends, to a great extent, on the viscosity and chemical nature of the carrier, this rate being low for oil of average viscosity and high for water, which has a relatively low viscosity.

Confirmation of this finding may be found in a paper by Messrs. Fogg and Hunwicks, entitled "The Static Friction of Lubricated Surfaces", published in the *Journal of the Institution of Petroleum Technologists* of January. To facilitate comparative tests, Messrs. Acheson have now developed a technique to which they have given the name 'pre-lubrication'. This consists simply of forming a graphite coating or film on the working surfaces prior to assembly, by spraying or brushing colloidal graphite on to them, the graphite being applied, in this case, in a volatile carrier such as carbon tetrachloride, white spirit or acetone. The rapid evaporation of the carrier leaves a lubricating graphited surface, thicker, naturally, than one deposited during normal lubrication, but functioning in much the same way. The formation of the initial film does not eliminate the necessity for using colloidal graphite in the lubricating oil during the normal running-in period, and afterwards if desired, since the graphited surface requires renewal from time to time.

Mammals and Man

REFERENCE was made in NATURE of Feb. 22, to the temporary exhibition "Mammals and Man" at the National Museum of Wales, and to the lack of references in the guide-book "to modern developments such as the varied and most important uses of whale oil, the increasing resort to mammal products in biological therapy", etc. Mr. Colin Matheson, curator of the Museum, informs us that a well-known British firm has provided samples of vitamin A concentrate prepared from whale liver, hydrogenated whale oils of various melting points, spermaceti, and other important cetacean products, for the exhibition. The exhibit was unfortunately delayed in transit owing to war conditions, and did not arrive until the guide-book was in the press.

William Withering

MARCH 17 marks the bicentenary of the birth of Dr. William Withering, who was celebrated alike as physician, botanist and mineralogist. He was born at Wellington, Shropshire, the only son of Edmund Withering, a surgeon. He received his medical education at Edinburgh, where he qualified in 1776 with a thesis on "Malignant Putrid Sore Throat", which he afterwards identified with a severe form of scarlet fever. After a visit to Paris, where he attended a meeting of the Royal Academy of Sciences, he settled in Stafford in 1767 and first began to collect flowers. In 1775 he moved to Birmingham, where he soon acquired a lucrative practice, and the following year published his most important work entitled "A Botanical Arrangement of all the Vegetables naturally growing in Great Britain". The book went through seven editions, and an abbreviated version, of which three were published, by W. Macgillivray, first appeared in 1830.

At Birmingham Withering became a member of the Lunar Society, so called from its monthly meetings, and made there the acquaintance of Priestley, Watt and other distinguished men of science. In 1779 he published his "Account of the Scarlet Fever and Sore Throat, particularly as it appeared in 1778–1779", which is an important contribution to epidemiology and clinical medicine. In 1785, when he was elected F.R.S., appeared his classical paper on the foxglove, the value of which in dropsy he had learnt from an old woman in Shropshire, an excellent example of a folk-lore remedy being adopted by the orthodox profession. His interest in mineralogy is shown by the several contributions to the *Transactions of the Royal Society*. He also translated and annotated a treatise entitled "Outlines of Mineralogy" by Bergman "(1783). During a visit to Lisbon in 1795 he wrote a paper on "A Chymical Analysis of the Water at Caldas da Rainha, in Portugal", which he presented to the Royal Academy at Lisbon, for which he was admitted a foreign corresponding member.

His name has been given to the mineral known as 'witherite', consisting of barium carbonate, which he recognized to be distinct from baryta, as well as to the genus of Solanacea (*Witheringia Solanacea*). In 1792 he contributed a paper entitled "A Method of preserving Fungi, ascertained by Chymical Experiments" to the *Transactions of the Linnean Society*, of which he was elected a fellow the following year. He died on October 6, 1799, and was buried at Edgbaston, where the church contains his monument with a representation of a foxglove on the right and of *Witheringia Solanacea* on the left.

Announcements

THE following promotions and transfers have recently been made in the Colonial Service: J. D. Broatch (agricultural superintendent), senior agricultural superintendent, Gold Coast; D. H. Brown (agricultural officer), senior agricultural officer, Nigeria; T. A. Buckley (chemist), senior chemist, Malaya; K. T. Hartley (chemist), senior chemist, Nigeria; L. J. Packham (agricultural superintendent), senior agricultural superintendent, Gold Coast; L. S. Davis (assistant Government analyst), Government chemist, Trinidad; E. J. Strugnell (senior assistant conservator), conservator of forests, Malaya; Dr. C. M. Tattam (geologist), senior geologist, Nigeria.

MESSRS. OLIVER AND BOYD LTD., Tweeddale Court, Edinburgh, and 98 Great Russell Street, London, W.C., have been appointed publishers to the Royal Society of Edinburgh. Copies of previous issues of the *Transactions* and *Proceedings* and of all future publications of the Society will now be supplied by this firm.

THE Canberra Experiment Station of the Plant Industry Division of the Australian Council for Scientific and Industrial Research is to be removed to a new area to the north of the capital, about four miles from the laboratories at Black Mountain. The area is eight hundred acres, of which six hundred are red and grey loams and the remainder rather lighter. The site is ideal for experimental work, and it should be possible in time to develop on it a first-class investigation centre.

ACCORDING to the seventeenth annual report of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, eighty-one applications for grants were received by the trustees, and twenty-three grants were made. In the seventeen years of its existence the Foundation has made three hundred and ninety-four grants, which have been distributed to investigators in most countries of the world. For the present, researches are being favoured that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery. Grants may be used for the purchase of apparatus and supplies that are needed for special investigations. The maximum grant will usually be less than 500 dollars. Applications for grants to be held during the year 1941–42 must be in the hands of the Executive Committee before April 1941. Applications should be sent to Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Massachusetts, U.S.A.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Nicotinamide, Cozymase and Tissue Metabolism

THE importance of cozymase as a fundamental constituent of certain respiratory processes in the living cell is now well established. It is known that cozymase is necessary for the activity in animal tissues of specific dehydrogenases oxidizing alcohol, lactate, malate, triosephosphate, etc. Its mode of action is reasonably clear. After combination with a dehydrogenase, it is reduced by a substrate (for example, lactate) with the formation of reduced cozymase and the oxidized product of the substrate (for example, pyruvate). The reduced cozymase is oxidized to its original form by other enzyme systems in the cell, transfer of hydrogen from the substrate to the final oxidizing agent being thus accomplished. Cozymase acts as a catalyst in the transfer of hydrogen in the cell, and in the intact tissue a dynamic equilibrium between reduced and oxidized cozymase is presumably always maintained.

Whilst carrying out investigations into the respiratory activity of tissues damaged by breaking up the cell structure we have found that such tissues (for example, brain, liver, kidney) possess an agent which breaks down cozymase at a rapid rate. The brain in particular is rich in this factor, as will be seen on examining the typical results shown in Table 1.

TABLE 1

Lactic dehydrogenase system consists of a mixture of skeletal muscle lactic dehydrogenase, heart muscle flavoprotein, sodium lactate solution (0·13 *M.*), sodium cyanide (0·083 *M.*) and methylene blue (0·017 per cent) in phosphate buffer (0·02*M.*) *p*H 7·4. Brain preparation consists of a suspension of finely ground rat brain (1 gm. to 10 ml. saline).

	Oxygen uptake at 37° in 1 hour
Lactic dehydrogenase system	24·0 c.mm.
+ cozymase (1 mgm.)	205·2 „
+ cozymase + 0·2 ml. brain preparation ..	108·9 „
+ cozymase + 0·4 ml. brain preparation ..	64·0 „
+ cozymase + 0·1 per cent nicotinamide ..	195·9 „
+ cozymase previously incubated for 15 min. at 37° with 0·2 ml. brain preparation ..	54·1 „
+ cozymase previously incubated for 15 min. at 37° with 0·2 ml. brain preparation + 0·1 per cent. nicotinamide	167·2 „

These observations show that the addition of a small quantity of a suspension of finely ground brain tissue to a system containing lactic dehydrogenase, cozymase, flavoprotein and lactate greatly diminishes the rate of oxidation of the lactate. This diminution of activity is due to the breakdown of cozymase by the brain suspension. This is shown (see Table 1) by adding to the lactic dehydrogenase system a cozymase preparation which had been incubated for a short period with a small quantity of brain suspension. Such addition leads to little or no increased respiratory rate, in contrast to that which takes place when cozymase alone is added to the system. It may be shown, too, that the inhibiting action of a small quantity of brain suspension on cozymase activity applies not only to the lactic dehydrogenase of rabbit skeletal muscle (results of which are given in Table 1) but also to that of a rat kidney preparation (see Tables 2 and 3). A result given in Table 2 shows that the factor present in brain which inactivates cozymase is also present in liver, and we have evidence to show it is present in kidney, though in smaller amount. Further evidence has been secured which shows that the inactivation of cozymase by tissues may take place under strictly anaerobic conditions and we conclude, for the time being, that the inactivation is due to a hydrolysis of cozymase by a nucleotidase.

TABLE 2

Kidney system consists of a suspension of finely ground rat kidney tissue (1 gm. to 10 ml. saline), sodium cyanide (0·083*M.*) and methylene blue (0·04 per cent). Liver preparation consists of a suspension of finely ground rat liver (1 gm. to 10 ml. saline).

	Oxygen uptake at 37° in 1 hour
Kidney system + sodium lactate (0·13 *M.*)	59·9 c.mm.
+ cozymase (1 mgm.)	189·4 „
+ cozymase + 2 ml. brain suspension ..	58·5 „
+ cozymase previously incubated with 0·2 ml. liver preparation	57·8 „

TABLE 3

	Oxygen uptake at 37° in 30 min.
Kidney system + sodium lactate (0·13 *M.*)	
+ cozymase (1 mgm.)	66·0 c.mm.
+ cozymase + nicotinamide (0·1 per cent) ..	89·8 „
+ cozymase + 0·2 ml. brain suspension ..	10·5 „
+ cozymase + 0·2 ml. brain suspension + nicotinamide (0·1 per cent)	77·1 „

It is evident that, since brain tissue contains a most active cozymase nucleotidase, rapid synthesis of cozymase must take place in intact brain tissue examined under optimal respiratory conditions in order to balance the nucleotidase activity and to account for the maintenance of oxidative activity of brain when this is allowed to respire *in vitro* in a lactate medium. (Alternatively it must be concluded that cozymase nucleotidase is ineffective in intact animal tissues under aerobic conditions.) Hence there must exist in intact tissue an equilibrium between the mechanisms responsible for synthesis of cozymase and those responsible for its breakdown. The existence of this equilibrium probably accounts partially for the fact that the respiration of minced or ground tissues is often much lower than that of intact tissues; in the former tissues synthetic mechanisms are impaired, probably by loss of cell constituents by diffusion, etc.

We decided it would be of interest to discover how the cozymase nucleotidase activity of ground tissues could be inhibited. We have found that nicotinamide

—a constituent of cozymase—brings about such an inhibition. Results given in Table 1 show that if cozymase is incubated in presence of a small quantity of brain suspension together with 0·1 per cent nicotinamide, very little breakdown of the cozymase takes place. Results given in Table 3 show the stimulating action of nicotinamide on the oxygen consumption, when this is added to a kidney preparation of lactic dehydrogenase to which cozymase and brain suspension have also been added. The effect of nicotinamide on the activity of brain tissue itself, in the presence of lactate and cozymase, is shown in Table 4, where typical results obtained by the technique of Quastel and Wheatley[1] are given.

TABLE 4

Brain system consists of 1 ml. brain suspension (1·6 gm. chopped rat brain in 16 ml. Locke solution), cozymase and sodium cyanide (0·05 *M.*) in bicarbonate-Locke medium (pH 7·4). Sodium ferricyanide (0·2 ml. 10 per cent) was added, in an atmosphere of 95 per cent nitrogen + 5 per cent CO_2, and the evolution of CO_2 measured.

	CO_2 output at 37° in 1 hour
Brain system	85·6 c.mm.
+ nicotinamide (1·0 per cent)	85·6 „
+ sodium lactate (0·13 *M.*)	107·5 „
+ sodium lactate (0·13 *M.*) + nicotinamide (1·0 per cent)	357·8 „

These results make it clear that nicotinamide exerts an inhibitory effect on the breakdown of cozymase by a tissue nucleotidase. A few experiments have indicated considerable specificity of nicotinamide in this respect. Nicotinic acid at the concentrations we have used has no effect. It would not be expected that nicotinamide would effect any stimulation of the respiration of intact tissues obtained from healthy animals since in such tissues the breakdown of cozymase is balanced by its synthesis. Experiment shows that 0·1 per cent nicotinamide does not increase the respiration of intact brain slices in a lactate medium. There is, on the contrary, a small inhibition of the respiration such as has already been reported by Baker, Fazekas and Himwich[2].

This demonstration of the action of nicotinamide in protecting cozymase from breakdown, possibly by competition for the nucleotidase, raises the question as to whether the well-known therapeutic effects of nicotinamide may not be due partly to this action. If this view is true, substances other than nicotinamide having a similar protective effect may have similar therapeutic effects. It is interesting to note in this connexion that Vilter and Spies[3] have shown that quinolinic acid will cure pellagra and that Wooley *et al.*[4] find that a variety of nicotinic acid derivatives will cure canine black tongue. Moreover, as a result of the administration of quinolinic acid there has been found[3] an increase in concentration of cozymase in the blood.

Work on this problem is still in progress and further details will be published in due course.

We are grateful to the Rockefeller Foundation and to the Medical Research Council for financial help.

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Jan. 24.

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[2] Baker, Fazekas and Himwich, *J. Biol. Chem.*, **125**, 545 (1938).
[3] Vilter and Spies, *Lancet*, II, 423 (1939).
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Rates of Oxidation of Isomeric Dihydroxy- and Tetrahydroxy-stearic Acids by Lead Tetra-acetate

MEASUREMENTS of the rate of consumption of lead tetra-acetate, when used in strictly comparable conditions to oxidize various isomeric polyhydroxystearic acids, have revealed marked differences between the speed of oxidation of isomeric forms. We have observed these differences both in the two isomeric 9, 10-dihydroxystearic acids (m.p. 95° and 132°) and in the four known forms of 9, 10, 12, 13-tetrahydroxystearic acids (m.p. 173°, 163°, 146° and 134°). Further measurements are in progress in the group of tetrahydroxy-acids, and the complete results of this work will be reported in fuller detail later.

The data in the accompanying table show the rate of oxidation of the two 9,10-dihydroxystearic acids when each (0·0005 mole) was oxidized in glacial acetic acid (100 ml.) containing lead tetra-acetate (0·001875 mole) at 20°:

Time (min.)	Moles lead tetra-acetate consumed per mole dihydroxystearic acid	
	Acid m.p. 95°	Acid m.p. 132°
0·5	1·23	0·10
1·5	1·48	0·18
2·5	1·60	0·27
3·5	1·64	0·37
4·5	1·70	0·45
10	1·78	0·64
25	1·87	1·05
55	1·95	1·48
100	1·97	1·72
160	2·01	1·80

The rate of oxidation of the acid, m.p. 95°, is far more rapid than that of the isomeric form, m.p. 132°. The difference in the rate of oxidation of the two acids is similar to that of many pairs of cyclic glycols; Criegee[1] has shown, in the case of the latter geometrical isomerides, that *cis*-glycols are attacked by lead tetra-acetate more rapidly than the *trans*-isomerides. In the acyclic polyhydroxystearic acids, however, the stereoisomerism is that of two (racemic) asymmetric carbon atoms, and is not a case of geometrical isomerism.

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[1] Criegee, *Ber.*, **64**, 260 (1931); **65**, 1770 (1932). *Ann.*, **507**, 159 (1933).

Pre-Precipitation Phenomena in Age-Hardening Alloys

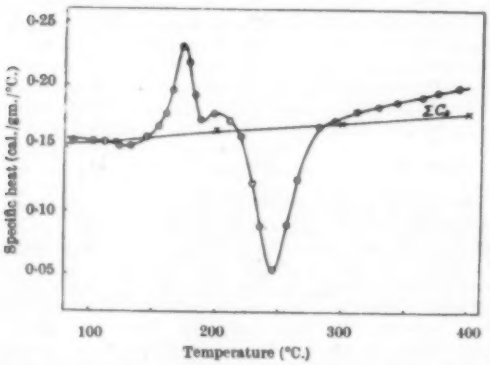
USING an improved X-ray technique, Preston[1] and Guinier[2] have shown that when aluminium-copper single crystals containing 4 per cent copper are aged at low temperatures, thin plates of copper-rich atoms are formed on (100) planes of the crystal. Swindells and Sykes[3] found, from specific heat measurements on a similar alloy, that when specimens previously aged at low temperatures were re-heated, heat was

absorbed before the chemical energy of precipitation was liberated. They suggested that this energy absorption was due to the dispersion of the copper-rich plates formed during the low-temperature ageing, an interpretation which was confirmed by Preston.

The fact that no change is observed in the lattice spacing of the crystal as a whole, even though nearly half the energy of precipitation may be released by the low-temperature ageing, suggests that the segregation of copper atoms is largely on the solid solution lattice, or in other words the precipitate has not broken away to form separate crystals, distinct from the matrix.

Aluminium-copper was the only alloy in which such pre-precipitation phenomena had been detected by X-ray methods, but recently Barrett and Geisler[4] have observed that plates of silver-rich atoms are formed on the (111) planes of a single crystal of an aluminium-silver alloy containing 20 per cent of silver, after ageing at low temperatures.

We have determined the specific heat - temperature curve of a specimen of an aluminium-silver alloy containing 40 per cent of silver quenched from 550° C. and aged for seven days at room temperature. The accompanying curve was obtained using the



method described by Sykes and Jones[5]. The line marked ΣC_p shows the specific heat of the alloy calculated from the specific heats of pure aluminium and pure silver. The specific heat - temperature curve found experimentally bears a marked resemblance to those of Swindells and Sykes on aluminium-copper and may be interpreted similarly. The energy measurements thus give some confirmation for the X-ray results of Barrett and Geisler.

Although these workers have not investigated the point, it is to be expected that what Mehl[6] calls retrogression, such as is observed in aluminium-copper alloys, would also occur in aluminium-silver alloys.

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[1] Preston, *Proc. Phys. Soc.*, **52**, 77 (1940).
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Weighing Living Marine Animals

THE substance of Dr. Gohar's letter[1] is contained in his fourth paragraph: "It is therefore possible to determine the volume and weight-in-air of such animals, excluding the water they contain, by weighing in two samples of water of different but known specific gravities". No experiments are described. The Archimedean formula is correctly stated on the assumption that the volume of the animal remains the same in the two samples of water: this can be true of few animals.

L. C. Beadle[2] experimented on the changes in sinking weight of the common polychaete worm *Nereis diversicolor* after transference from sea water to various dilutions. Nereis is a favourable subject since it is markedly euryhaline; the specimens observed were gathered from an estuary where, with rising and falling tide, the worms changed twice a day from an environment of sea water to one diluted by river water, sometimes down to 60 per cent of its former salinity. Schlieper is quoted as having collected Nereis in water of salinity equivalent to only 12 per cent of sea water.

Beadle finds that after transference from 100 per cent to 25 per cent sea water "the weight rose to a maximum after 5–7 hours and then fell to a relatively steady value at 24–30 hours". The following extract showing separate observations on six individuals destroys any hope of measuring accurately the volume of Nereis by Dr. Gohar's method. From Table IV:

Percentage increase in weight in 25 per cent sea water, specimens *a–f*:

After 4½ hours:	(*a*) 47 per cent	(*b*) 54 per cent
„ 22½ „ :	(*c*) 87 „	(*d*) 135 „
„ 50½ „ :	(*e*) 74 „	(*f*) 35 „

The body-fluid concentration was measured in terms of the isotonic percentage of sea water. In 100 per cent sea water this lay between 99 and 101 per cent, but in dilute environments the body-fluid was always markedly hypertonic to the surrounding medium. Thus, in the four specimens *c–f*, which had been more than 22 hours in 25 per cent sea water, the body-fluids ranged in isotony from 37 to 42 per cent sea water: that is, 50–70 per cent above the surrounding medium. No attempt can be made here to summarize Beadle's very interesting discussion of the parts played by muscular contraction, nephridial action, etc.; it is sufficient that the experimental facts disprove Dr. Gohar's prophecy that when the salinity of the environment is changed "the existence of a physico-chemical equilibrium may be foretold".

Since sponges figure first on the list of animals for which "this method is especially suitable", I must point out that from one quarter to three quarters of the volume of a sponge consists of an intercellular jelly, often very watery, the bulk of which must be greatly affected by osmosis; also in 1895 I figured[3] changes in form of collar-cells in response to changes of salinity and/or *p*H. Measurement shows that they are accompanied by change of volume of the cells.

In 1923 I published[4] a determination of the volume of a preserved *Leucandra aspera* hardened in alcohol. The sponge was weighed in alcohol of different strengths and in water; I confess that this involved an error similar to Dr. Gohar's, for I now recognize that the hardened cells swell in weaker alcohols and shrink again when dehydration is repeated.

Three years ago, A. G. Lowndes published[5] a very beautiful method for obtaining the volume of living marine organisms, estimating by titration the amount of chlorides in a specific gravity bottle filled with sea water and comparing it with the amount in the same bottle filled with sea water containing a Nereis: the difference gives the amount of chlorides displaced by the Nereis and hence the volume of sea water displaced. The filled specific gravity bottle is in each case weighed, and the difference between the weights is the difference between the weights of that volume of sea water and that volume of Nereis.

Since then, Mr. Lowndes has been kind enough to show me, from time to time, the results of similar measurements in which I was interested. They are remarkably consistent and in his hands the method seems very perfect.

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Feb. 20.

[1] NATURE, Feb. 8, 1941.
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Symbiosis in Larval Siricidæ (Hymenoptera)

THE presence of a symbiotic basidiomycete fungus in the adult females of the woodwasp *Sirex gigas* L. was first described by Buchner[1]. Subsequent work by Cartwright[2,3] and Francke-Grossmann[4] has shown that the fungi in this and other species can exist independently and are, in fact, common wood-destroyers. Each egg as it passes into the ovipositor is coated with oidia of the fungus, which grows into the wood in advance of the tunnelling larva and may be the insect's source of food. Francke-Grossmann[4] could find no fungus in the larva, except in the alimentary canal, and decided that the immature female wasp becomes infested by hyphæ growing from the wall of the tunnel into the special intersegmental pouches very soon after the pupal skin is shed.

During a re-investigation of the whole subject, my observations on *S. gigas* L. and *S. cyaneus* F. have confirmed those of the above authors. In addition, fungus has been located in the larva in special organs arising from a modification of the integument on the posterior side of the hypopleural folds on the first abdominal segment. The cuticle is deeply pitted in a characteristic way, and the underlying hypodermal cells are greatly enlarged and probably have a special secretory function. In sections, the fungus can be clearly seen in the pits. The organs were found in a proportion of the larvæ corresponding approximately to the sex ratio of the adults and pupæ cut from the same section of log, suggesting that they are present in female larvæ only. The fungus in these larval organs has been isolated into pure culture and found to be *Sterum sanguinolentum* (A. and S.) Fr.; this species has been shown by Cartwright to be present both in larval tunnels and the intersegmental pouches of the adult female woodwasp.

The significance of these organs in the larvæ has yet to be explained, particularly in relation to the absence of fungus from the pupal stage of the insect. The problems of the part they play in the symbiotic cycle and of their fate during ecdysis are extremely interesting, since the structures are external. The work has now had to be suspended, but an account of the progress to date is being prepared for publication elsewhere.

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[1] Buchner, P., "Holznahrung und Symbiose" (Berlin, 1928).
[2] Cartwright, K. St. G., *Ann. Appl. Biol.*, **26**, 184–87 (1929).
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Staining of Bacteria and Certain Fungi

THE usual method for staining bacterial and yeast spores requires three operations: the staining of both spores and vegetative cells by applying heat to the slide bearing the dye; the removal of stain from the vegetative cells with a decolorizing agent; and counterstaining the vegetative cells with a dye of a different colour. The same treatment is used to differentiate acid-fast bacteria from others.

A solution has been developed for staining spores and vegetative cells differentially in one operation. Fixed films of bacteria or yeasts are stained for one minute over steam with a solution consisting of malachite green 0·5 per cent, basic fuchsin 0·05 per cent, in distilled water; the film is then washed and dried. Spores are stained greenish blue, other cells violet or, in older cultures, pink. Acid-fast bacteria retain the greenish-blue tinge, and may show the presence of violet granules; all non-acid fast bacteria so far tested are stained violet.

A saline dilution of the staining solution has been developed especially for differentiating the hyphæ and conidia of certain fungi in agar plate cultures.

A paper giving other details will shortly appear in the *Canadian Journal of Research*.

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Jan. 17.

An American Message

THE Editor and staff of *Bell Laboratories Record* present their compliments to the Editors of NATURE and congratulate them on the continued regularity and high quality of the publication, under extraordinary difficulties. They are happy to report the strong public sentiment here, as to aid for Britain.

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RESEARCH ITEMS

Hungarian Throwing Sticks

POSSIBLE ethnological affinities for a 'casting staff' in use in Hungary some thirty to forty years ago have been suggested by Béla Garda, of the Ethnographical Museum, Budapest (*Man*, Jan. 1941). The Hungarian casting staff was a characteristic weapon of the herdsmen, who were never without them. They were used in fights among the herdsmen themselves or against wolves attacking their herds. Cattle thieves also employed them to drive off anyone attempting to intercept them on their marauding expeditions. The casting staff was a rounded wood cudgel, 65 cm. long and 5 cm. in diameter and pointed at each end, the points being hardened by fire. In throwing, it was held at one end, and it was effective up to 50–100 paces. It appeared first on the Greater and Minor Kunsag of the Hungarian plateau, where a pastoral life was the characteristic condition. Literary references to it are found from the fifteenth century onward. This throwing staff is entirely different from the throwing sticks and boomerangs of European prehistoric and later times. An identical form, however, is found in the Malay Peninsula, in Borneo and Marshall, Gilbert and Yap Islands. Zs. Bátky, the Hungarian ethnologist, is of the opinion that the Hungarian weapon was brought by the Hungarians from the East, its ancient home being the great steppe lands of Asia. In support of this, it is here pointed out that the social organization and civilization of the Hungarian herdsmen show the marked eastern character of the horse-nomads. It is possible, therefore, that the connexion between the casting staves of Hungary and Indonesia-Micronesia may be placed in the same great prehistoric-ethnological culture-frame to which belong the conformities of the Asiatic nomad cultures and of the Oceanic culture of the Farther Indies.

Saxon Relics from Lincolnshire

St. Peter's Church at Barton-on-Humber, North Lincolnshire, one of the oldest churches in England, dates in part from Saxon times; but up to the present, little evidence has been obtained as to the people by whom it was first built. Recent excavations for an air-raid shelter brought to light two or three human skeletons and some pieces of metal which were handed to T. Sheppard of the Hull Museum, by whom the site was visited, and these and later finds are now described (*Hull Mus. Pub.*, No. 208; 1940). It was evident that a number of Anglo-Saxons had been buried just below the original surface, which at a later date had been covered by 5–6 ft. of boulder clay. The bones showed that one body was that of a woman, while another was that of a man of large proportions aged about 45 years. The most interesting find was a large thin bronze bowl with three escutcheons with hooks, each fastened with three bronze rivets; otherwise it is devoid of decoration. It is comparable with other bowls of this type found with Saxon remains, but which T. D. Kendrick has assigned to a Romano-British or British origin. Remains of a trivet with two feet suggest the deposit at Barton of a second bowl of the trivet stand type, but the bowl itself has not been found. Another interesting object was a cylindrical bronze box with a bronze loop, presumably for attachment to a lady's chatelaine. Such boxes were used for carrying sewing or other materials. A long gold bead is unique among Anglo-Saxon gold beads. Extension of the excavation raised the number of skeletons to five in all, and produced a very fine short sword, a set of scales and weights, remains of a bone comb, a large decorated bronze handle and a heavy curved piece of bronze. The scales consist of two plain pans, slightly concave, each 2¼ in. in diameter, and each perforated for three bronze rings for suspension. The balance beam is of circular bronze wire 5 in. long with zoomorphic terminals, such as have not previously been recorded on balance beams. Beneath each terminal is a loop containing a small bronze ring. From the centre rise two upright pieces of bronze 2 in. in length. Swinging between the two is a pointer of bronze 1 in. in length. Four metal weights ranged from 200·4 grains down to 95·9 grains; other pieces of metal and a Roman coin presumably used as weights from 39·9 grains down to 8·7 grains. A few days after the find of a hanging bowl at Barton, a similar bowl was found at Manton Common, Lincs, while a fine example was found at Caistor in 1857.

Minor Plant Diseases

W. C. MOORE has described three minor plant diseases (*Trans. Brit. Mycol. Soc.*, 24, Pts. 3 and 4, 345–351; Dec. 1940). An angular leaf spot of the apple, previously attributed to the fungus *Phyllosticta angulata* and another species, is now shown to be initiated by an insect, the frog-hopper *Cercopsis sanguinea*. The fungi are there as secondary parasites, but only serve to accentuate a malady already present on the foliage. Leaf spot of lettuce, caused by *Septoria lactucæ*, was observed in Harpenden during the summer of 1940. Infected plants formed hearts, but were very unsightly. Colchicum plants are subject to attack by the fungus *Pythium ultimum*, which is also the cause of watery wound rot in Duke of York potatoes and a rot in tulip bulbs. The disease in Colchicum appears usually during the summer, and indeed some corms are completely disorganized when lifted. Pathogenicity has been established by inoculation with pure cultures.

Origin of Secondary Trisomics

M. M. RHOADES (*Genetics*, 25, 483–520; 1940) has provided cytogenetical evidence that a secondary trisomic involving chromosome 5 of maize arose from an abnormal chromosome which consisted of one arm of chromosome 5 and therefore had a terminal centromere. This terminal centromere is shown to be unstable both in meiosis and mitosis. Transverse division of the centromere during the first microspore division would give a chromosome with a median centromere and two identical arms. Cytogenetical evidence is given of the mode of disjunction in a trivalent and of the linkage group 72 units in length involving 8 genes.

Experiments in Selection

THE number of hairs on the ventral surface of the fourth and fifth abdominal segments are inherited as polygenic characters in *Drosophila melanogaster*. K. Mather (*J. Gen.*, **41**, 159–194; 1941) subjected the F_2 of certain crosses to selection for the number of such hairs. In one cross, the greatest change in hair number took place in the first two selected generations. In another cross involving two different stocks, an advance with selection took place in the first two selected generations, followed by a period of stability which was again followed by a considerable advance. By intercrossing the inbred selected lines a greater variation was found in their F_2 as compared with that of the original F_2. This is interpreted to mean that the first advances are due to recombination of independent genes and the second to recombination of linked genes. This presupposes the existence of a balanced combination of genes controlling polygenic characters in one chromosome. Such linked genes will be favoured by natural selection, since the mean expression of a selected variable character will almost coincide with the optimum in the population. Stability of this mean is necessary in the present environment and is achieved by linkage, whereas ability to vary with changing environment is necessary for evolution and is brought about by crossing-over by linked genes. The author therefore accounts for clines in wild populations.

Estimation of Carbon Dioxide in Air

A NEW method of estimating small quantities of carbon dioxide in air by the absorption of infra-red radiation is described by H. Dingle and A. W. Pryce in *Proc. Roy. Soc.*, B, **129**, 468–474 (1940). Older methods of making this measurement, which is of considerable importance in plant and animal physiology as well as in chemistry, depend on chemical processes or on measurement of the electrical conductivity of solutions in which the carbon dioxide is absorbed. In 1937, however, McAlister introduced a spectrometric method, in which the amount of carbon dioxide was estimated directly from the amount of absorption, by the air under examination, of infra-red radiation near 4·3 μ, the maximum of a strong absorption band of carbon dioxide. The radiation, after passing through the air, was received by a spectrometer set at this wave-length. Dingle and Pryce, however, show that the spectrometer is unnecessary if the air is dried, since the only atmospheric gases which absorb radiation in the near infra-red are carbon dioxide and water vapour. It is therefore necessary merely to compare the total radiation from a bunsen burner transmitted by the air under examination, with that transmitted by a standard quantity of dry air free from carbon dioxide, in order to determine the amount of carbon dioxide present. The amounts of radiation transmitted by the two samples of air fall on two thermopiles connected so that the galvanometer shows the difference in the currents produced. In addition to its greater convenience, this method has three advantages over the measurement at the maximum of the absorption band; it eliminates the cost of the spectrometer, it gives much greater sensitivity since the whole of the transmitted radiation is used, and it is much less affected by variations of temperature, which change the position of the absorption band but do not greatly alter the total absorption.

Surface Effect in Slow Combustion of Hydrocarbons

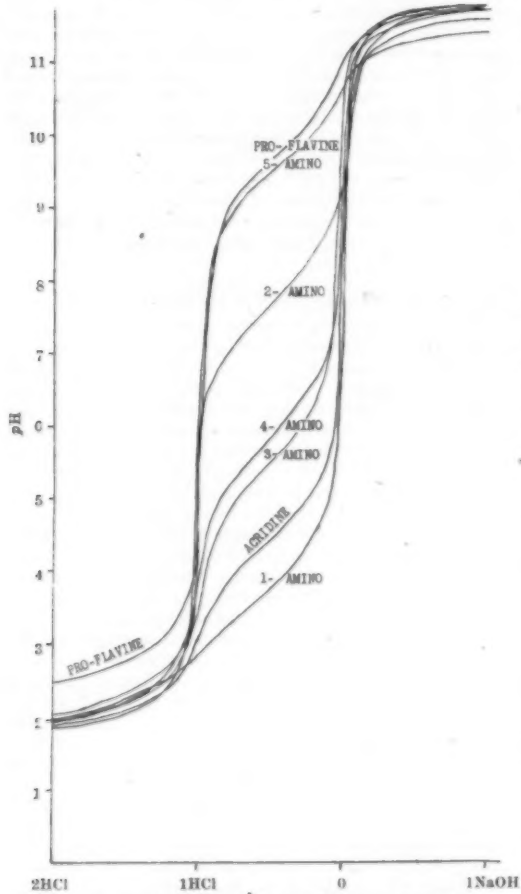
A SYSTEMATIC study has been made by R. G. W. Norrish and J. D. Reagh (*Proc. Roy. Soc.*, A, **176**, 429–48; 1940) of the effect of surface on the slow oxidation of several hydrocarbons, both saturated and unsaturated. Special reaction vessels of approximately constant volume but widely varying diameter were used. All reactions were of the degenerate branching type, and were found to be principally homogeneous in character. When the diameter of the reaction vessel was sufficiently reduced, the reaction rate fell abruptly towards zero, whilst the corresponding induction period increased towards infinity. In narrow vessels, surface deactivation can predominate over other processes of deactivation. In wider vessels, surface and volume deactivation occur to a comparable extent over a considerable range of pressure. The surface deactivation almost alone can suppress the factors leading to chain branching when the vessel diameter is decreased to a critical value. From the reactions studied, the occurrence of this critical diameter appears to be general for hydrocarbon oxidation, in conformity with the theory of degenerate branching.

Motion of Solar Prominences in Three Dimensions

THE application of kinematography to the spectrohelioscope has given us, during the past few years of solar activity, some spectacular motion pictures of solar prominences. Outstanding among the institutions engaged in this fascinating work is the McMath-Hulbert Observatory on Lake Angelus, Mich. A further development is now reported from this station (*Publ. Obs. Univ. Mich.*, **8**, 57; 1940): a new spectroheliograph has been designed to give a continuous record of the line-of-sight motions of solar phenomena, particularly of prominences at the limb. The instrument differs from an ordinary spectroheliograph only in the motions executed by the slits in making the record. The first slit is narrow, as is an ordinary entrance slit, and during the recording it scans the prominence image and the adjacent sky intermittently at positions separated by 2 mm. intervals. The second slit is 2 mm. wide and limits the length of the spectrum recorded on the film to 1 mm. on either side of (say) the $H\alpha$ line, which appears in absorption in the light of the sky and in emission in the prominence. The intermittent motion produces a series of such strips placed end to end, and the grid of absorption lines so formed is used to detect at various points in the prominence those displacements of the emission line which are characteristic of line-of-sight motions. In order to facilitate identification of the feature whose radial velocity is being recorded, the wide second slit is automatically narrowed after the intermittent exposure, and a continuous scan then superposes a faint prominence picture on the grid of absorption lines. The whole cycle is then repeated with the first slit moved on, with respect to the solar image, by its own width; and so on until the whole 2 mm. is covered. No part of the prominence, then, can escape the intermittent scan, and on completion of twenty such cycles, a record of the radial velocity at all points on the image has been obtained. Correlation of such records with conventional spectroheliograms taken simultaneously will give three-dimensional pictures which cannot fail to add considerably to our knowledge of prominence motions.

CORRELATION OF BASICITY AND ANTISEPTIC ACTION IN AN ACRIDINE SERIES

THE amino acridines are unique among antiseptics in combining a high bacteriostatic activity in the presence of tissue fluids with a relative innocuousness to leucocytes. Hence any information that relates their physical and chemical properties with their antibacterial action is of general interest. The effect on bacteriostatic activity of varying the positions of amino groups in the acridine nucleus has already been studied in a series of *di*aminoacridines[1] which included the widely used antiseptics proflavine (2 : 8-diaminoacridine) and acriflavine. The contribution of each amino group towards the total effect was therein assessed, thus virtually predicting the antiseptic properties of the five isomeric *mono*-aminoacridines.



POTENTIOMETRIC TITRATION CURVES OF ACRIDINE AND DERIVATIVES

These five monoaminoacridines have now been examined for their antiseptic activity and the results correspond to those predicted. It is noteworthy that two of these simpler monoamines are approximately equal in bacteriostatic effect to the best of the diamines (for example, proflavine).

Further, potentiometric titration of these bases now reveals a remarkable correlation between their strength as bases and their antiseptic activity, the one increasing with the other. The results of these experiments, in which acridine and proflavine have been included for comparison, are condensed in the accompanying table and graph.

These figures represent the highest dilution inhibiting growth after incubation at 37° C. for forty-eight hours (when growth took place in No. 1 dilution, '0' was recorded). All experiments were carried out, in duplicate, according to the method of Garrod[1], which was extended to a wider variety of organisms. The streptococcus was a highly virulent Group A type, the *Staphylococcus aureus* was freshly isolated from a human infection and the *Clostridium Welchii* from a case of gas-gangrene. The latter organism proved the most susceptible of those tested, streptococcus, staphylococcus, *B. coli* and *proteus* following in that order, thus demonstrating a greater activity against Gram-positive types (cf. Browning[2]).

The titrations shown in the graph were carried out at 20° C. by running *N*/1 hydrochloric acid followed by *N*/1 sodium hydroxide into 30 mils of a solution of 0·0005 gm. mol. of the base in 67 per cent methanol.

CORRESPONDENCE BETWEEN BASICITY AND ANTISEPTIC ACTION

Substance	Medium: Broth pH 7·4				Medium: 10% serum-broth pH 7·2				Bacteriostatic Index (sum-total of inhibitory dilutions)	*pK* in water*	*pK* in 67% aqueous methanol*
	Cl. Welchii	*Strept. Haem. A.*	*Staph. aureus*	*B. coli*	*Cl. Welchii*	*Strept. Haem. A.*	*Staph. aureus*	*B. coli*			
	Proteus vulgaris				*Proteus vulgaris*						
									Strong antiseptics	Strong bases	
5-Aminoacridine	6	5	3	3	7	6	3	4	43	9·5	9·34
Proflavine (2:8-diamino-acridine)	6	6	3	2	7	6	3	2	41	9·1	9·50(in 50% methanol)
2-Aminoacridine	6	5	2	3	7	4	3	3	41	8·1	7·60
4-Aminoacridine	4	3	0	1	5	2	1	1	17	5·5	5·74
3-Aminoacridine	4	3	1	1	5	2	1	0	17	5·1	5·30
Acridine	3	2	1	0	3	1	1	1	12	4·3	4·54
1-Aminoacridine	3	1	0	0	2	1	1	0	↓ 8	4·0 ↓	3·68
									Weak antiseptics	Weak bases	

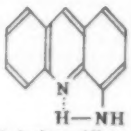
* *p*K represents—log. acidity constant (*K*). $K = \frac{(B)\,(H^+)}{(BH^+)}$

Key to Dilutions: 1 = 1 gm. antiseptic in 5,000 ml. of medium. Similarly, 2 = 1 in 10,000; 3 = 1 in 20,000; 4 = 1 in 40,000; 5 = 1 in 80,000; 6 = 1 in 160,000; 7 = 1 in 320,000 and 8 = 1 in 640,000.

This solution was contained in a beaker fitted with stirrer, glass electrode and KCl-agar bridge connected to a calomel-half-cell, and a Leeds and Northrup universal *p*H potentiometer assembly. Similar results were obtained when water replaced methanol, but, owing to the base being in suspension, some difficulty was experienced in reaching equilibrium within a reasonable time. The acidity constants, calculated from both sets of results, are compared in the table. It will be seen that, with increasing strength of base, there is a progressive increase in bacteriostatic activity. It appears likely that proflavine and 5-aminoacridine are as strong bases as is desirable, since we have observed that a number of more basic diaminoacridines are equal or inferior to these.

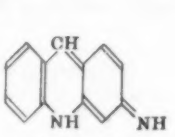
Finally, we have attempted to correlate these great variations in basicity of a series of isomerides with their molecular structure. Acridine, the dissociation constant of which has not been previously recorded ($3{\cdot}4 \times 10^{-10}$ at 20° in 67 per cent methanol; 2×10^{-10} in water) is seen to be a base of similar strength to aniline ($5{\cdot}2 \times 10^{-10}$ at 25° in water) and forming a natural series with quinoline ($1{\cdot}1 \times 10^{-9}$ at 25°) and pyridine ($2{\cdot}4 \times 10^{-9}$ at 25°). The increased basic strengths of 3- and 4-aminoacridines compared to acridine appear reasonable for the addition of an amino group, whilst the reduced strength of 1-aminoacridine is attributed to hydrogen bonding:

Acridine

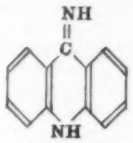


1-Aminoacridine

On account of the remarkably high basicity of the 2- and the 5-aminoacridines, it is preferable to represent these as the tautomeric acridonimines, as follows:



2-Aminoacridine



5-Aminoacridine

and this is consonant with the considerably greater basicity of the imino group compared to the amino group in the guanidine, thiourea, auramine and triphenylmethane series[3]. It is interesting to note that 4-aminopyridine (identical with the middle ring of 5-aminoacridine) is much more basic ($K = 1{\cdot}3 \times 10^{-5}$) than its isomerides[4].

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[1] Albert, A., Francis, A., Garrod, L. P., and Linnell, W. H., *Brit. J. Exper. Path.*, **19**, 41 (1938).
[2] Browning, C., *et al.*, *Proc. Roy. Soc.*, B, **93**, 329 (1922).
[3] Lecher, H., and Graf., F., *Annalen*, **438**, 154 (1924); **445**, 61 (1925). Sidgwick, N. V., "The Organic Chemistry of Nitrogen", pp. 93, 97, 281 and 297 (Oxford, 1937).
[4] Tropsch, H., *Sitzungsberichte der Kais. Akad. Wien*, (2B) **123**, 297 (1914).

ELECTRIC DISCHARGE LAMPS

DR. CLIFFORD C. PATERSON, director of the Research Laboratories of the General Electric Company, Ltd., has written an interesting review of the technical progress made last year in the development of electric discharge lamps (*Electrician*, Jan. 31). Last year he directed attention to the new problems which the 'black-out' has raised so far as general outdoor and shop-lighting are concerned. Except in special instances, these problems offer little scope for discharge lamps. On the other hand, the intensification of the War, while making these outdoor lighting (or darkening) problems more acute, has also created a greater need than ever for high efficiency light sources for our factories and workshops—a need which the existing discharge lamps go a long way to meet.

Mains voltage tubular fluorescent lamps, which follow naturally on the high-voltage fluorescent tubes in use in Great Britain since 1933, were introduced in the United States two years ago, and the demand last year reached several million lamps. The American lamps are made in a range of wattages and colours, particulars of which are given in the following table. The stated efficiencies are high, being 38 L./w. for the 30 w. daylight colour and 45 L./w. for the 30 w. white.

U.S.A. MAINS VOLTAGE, TUBULAR, FLUORESCENT LAMPS

Lamp wattage	Length (in.)	Diameter (in.)	Colours
15	18	1	Daylight, white, blue, green, pink, gold, red.
20	24	1½	
30	36	1	
40	48	1½	Daylight, white.

Dr. Paterson gave a general description of these lamps in his review last year, when their introduction in Great Britain was foreshadowed. Although the main programme on tubular fluorescent lamps has been held up in Great Britain until after the War, a special lamp to meet the requirements of war-time industry was put on the market early last year. This lamp, which is rated at 80 w., is 5 ft. long and 1½ in. in diameter. The quoted average life is 2,000 hours, by which time the efficiency has fallen to about 70 per cent of its initial value of 35 L./w., due to the action of the mercury vapour discharge on the fluorescent coating.

The introduction of the new fluorescent lamp is a step of real importance for the illumination engineer and the public alike. A condenser of about 0·05 mfd. is placed across the lamp to prevent radio interference. The power factor correction condenser has a capacity of about 0·75 mfd. and gives an overall power factor of about 90 per cent. When the supply voltage is

first switched on by closing the mains switch, the starting switch, which is either thermally or magnetically operated, short-circuits the lamp and allows the filamentary electrodes to heat up. The starting switch then opens automatically, inducing a momentary voltage kick across the lamp high enough to start the discharge.

The tube when alight has a creamy white appearance, the brightness being about 0·5 candles per sq. cm. The colour of the light, which is determined by the fluorescent coating, has been chosen very carefully to give an effect approximating to noon sunlight; the colour-rendering properties are excellent—very much better than those of ordinary incandescent filament lamps. It is not possible to obtain satisfactory colour-rendering by the use of a single fluorescent powder, since all the known powders give bands of light with a well-defined maximum in some region of the visible spectrum, but are deficient in light from other regions. To overcome this difficulty the fluorescent coating comprises a number of different powders, selected so that the peaks of their emission bands occur in complementary regions of the visible spectrum. The proportions of the component powders present in the mixture are adjusted to give the required luminosity distribution throughout the spectrum. The increase in light output due to the fluorescent coating is about 800 per cent. This application of fluorescent powders to obtain high-efficiency sources of white light was first developed in Great Britain in connexion with high-voltage tubular lighting.

Experience gained so far indicates that the new fluorescent lamp has applications in many spheres of industry and commerce, such as fine assembly benches, inspection benches, drawing and general offices, and in any situation where high-efficiency illumination approximating to daylight in its general properties is required. A range of trough reflector fittings, suitable either for high-intensity local lighting or for general lighting from greater heights, is available for use with the lamps.

FORTHCOMING EVENTS

Monday, March 17

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Capt. Graham Rowley: "Crossing Baffin Land".

Tuesday, March 18

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. C. W. Hobley: "Wild Life Conservation in its Wider Aspects."

Wednesday, March 19

INSTITUTE OF CHEMISTRY (London and South-Eastern Counties' Section) and the INSTITUTE OF PHYSICS (London and Home Counties' Branch) (Joint Meeting), (at the Royal Institution, Albemarle Street, London, W.1), at 2.30 p.m.—Dr. J. J. Fox: "Infra-Red Absorption and Molecular Structure".

Thursday, March 20

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.45 p.m.—Mr. G. E. Briggs, F.R.S.: "Photosynthesis in Intermittent Illumination". Mr. E. C. Bullard and Mr. T. F. Gaskell: "Submarine Seismic Investigations."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PRINCIPAL of the Leeds College of Technology—The Director of Education, Education Department, Calverley Street, Leeds 1 (March 29).

DEMONSTRATOR IN ANATOMY at St. Thomas's Hospital Medical School—The Dean of the Medical School, Manor House, Godalming, Surrey (March 30).

PART-TIME DEMONSTRATOR IN BIOLOGY—The Principal, Technical College, Kingston-upon-Thames, Surrey.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Empire Cancer Campaign. Seventeenth Annual Report of the Grand Council. Edited by J. P. Lockhart-Mummery. Pp. 280. (London: British Empire Cancer Campaign.) [52

Greece No. 1 (1941). Convention between His Majesty in respect of the United Kingdom and His Majesty the King of the Hellenes respecting the relations of Learning and Culture between Great Britain and Greece, Athens, December 30, 1940. (Cmd. 6250.) Pp. 7. (London: H.M. Stationery Office.) 2*d*. net. [102

University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (D. T. A. Townend) for the Session 1939–40. Pp. 15. (Leeds: The University.) [102

University of Birmingham. Report of the Vice-Chancellor and Principal to the Council for the Fortieth Session, 1939–40. Pp. 38. (Birmingham: The University). [102

Eleventh Annual Report of the National Smoke Abatement Society. Pp. 28. (Woodborough, Nottingham: National Smoke Abatement Society.) [102

University of St. Andrews. Handbook of the United College. Pp. 30+10 plates. (St. Andrews: The University.) [102

Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. Degrees in the University of Cambridge during the Academical Year 1939–1940. Pp. 118. (Cambridge: Printed at the University Press.) [102

Other Countries

Records of the Geological Survey of India. Vol. 75, Professional Paper No. 6: Did the Indobrahm or Siwalik River Exist? By Dr. M. S. Krishnan and N. K. N. Ayengar. Pp. 24. (Calcutta: Geological Survey of India.) 5 annas; 6*d*. [52

Memoirs of the Geological Survey of India. Vol. 76, Water-Supply Paper No. 1: The Geology and Underground Water-Supply of Calcutta, Bengal; with Special Reference to Tube-Wells. By Dr. A. L. Coulson. Pp. vi+150+ix+4 plates. (Calcutta: Geological Survey of India.) 3·12 rupees; 6*s*. [52

Indian Forest Records (New Series). Utilization, Vol. 2, No. 2: The Formation of Growth Rings in Indian Trees, Part 2: (a) Champ (*Michelia champaca*); (b) Kokko (*Albizzia lebbek*); (c) Toon (*Cedrela toona*). By Dr. K. Ahmad Chowdhury. Pp. iii+41–58+4 plates. 12 annas; 1*s*. Entomology, Vol. 6, No. 5: New Cerambycidæ from India, 2, Coleoptera. By W. S. Fisher. Pp. ii+197–212. 8 annas; 9*d*. Entomology, Vol. 6, No. 6: New Indian Cerambycidæ (Coleoptera). By J. C. M. Gardner. Pp. ii+213–226. 9 annas; 10*d*. (New Delhi: Manager of Publications.) [52

New Zealand: Department of Scientific and Industrial Research. Geological Memoir No. 5: Metamorphism in the Lake Wakatipu Region, Western Otago, New Zealand. By C. Osborne Hutton. Pp. 90 (17 plates). (Wellington: Government Printer.) 6*s*. [52

Annual Report of the Agricultural Meteorology Section, India Meteorological Department, for the Year 1938–39. Pp. vi+48. (Simla: Government of India Press.) [52

Report on the Administration of the Meteorological Department of the Government of India in 1939–40. Pp. iii+35+8 plates. (Delhi: Manager of Publications.) 1·2 rupees: 3*s*. 9*d*. [52

Publications of the Observatory of the University of Michigan. Vol. 8, No. 4: A Method of Measuring Radial Velocities in Solar Prominences. By Robert R. McMath, with the collaboration of H. E. Sawyer, Orren Mohler and J. Brodie. Pp. 57–60+1 plate. (Ann Arbor, Mich.: University of Michigan.) [52

Catalogue of Indian Insects. Part 25: Thysanoptera. By Dr. T. V. Ramakrishna Ayyar and V. Margabandhu. Pp. iv+64. (Delhi: Manager of Publications.) 2·2 rupees; 3*s*. 9*d*. [52

Sudan Government: Department of Agriculture and Forests. Annual Report, Part 2: Being the Report of the Agricultural Research Service for the Year ended 31st December 1938, relating to Experimental Results obtained in the Crop Season 1937–38. Pp. 124. (Wad Medani: Agricultural Research Institute.) [52

Rainfall in Queensland: Tables showing Monthly and Annual Rainfall Totals at 110 Selected Stations covering all available Years of Record up to and including 1939. Pp. 168. (Crohamhurst: Crohamhurst Observatory.) [102

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-Sè (Chine). Tome 21, Fascicle 5: Tables des planetes 512, 700, 770, 800. Par le P. E. de la Villemarqué. Pp. 30D. (Zi-ka-wei: Observatoire.) [102